

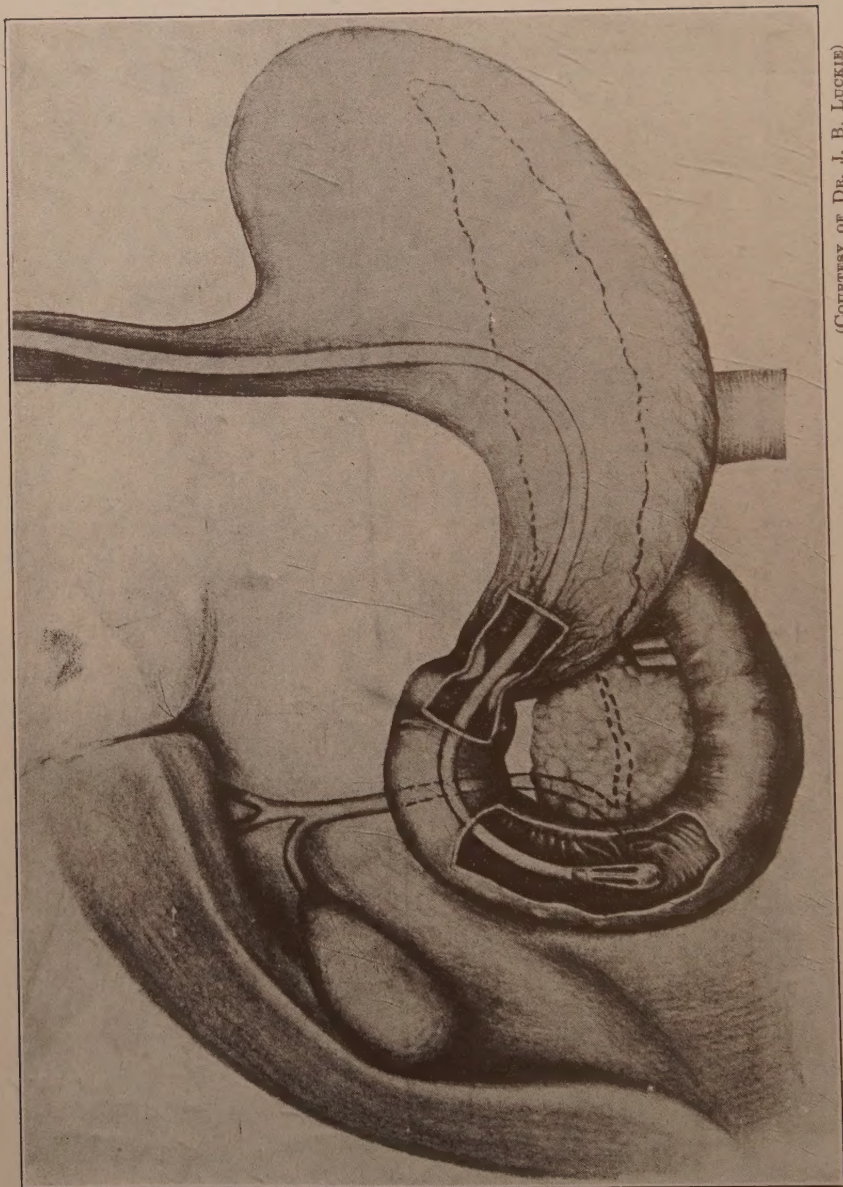
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PLATE I



(COURTESY OF DR. J. B. LUCKIE)

NON-SURGICAL DRAINAGE OF THE GALL TRACT

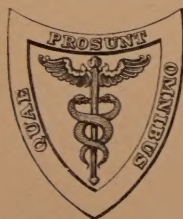
A TREATISE CONCERNED WITH
THE DIAGNOSIS AND TREATMENT OF CERTAIN DISEASES OF THE
BILIARY AND ALLIED SYSTEMS, IN THEIR RELATION TO
GASTRO-ENTEROLOGY AND GENERAL
CLINICAL MEDICINE

BY

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ILLUSTRATED WITH 175 ENGRAVINGS AND 10 COLORED PLATES



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TO
MY WIFE

WHO NOT ONLY HAS ENCOURAGED ME TO WRITE
BUT ALSO HAS ENABLED ME TO FIND THE TIME IN WHICH TO DO IT

AND TO
THE CHRONIC GASTRO-INTESTINAL INVALID
WHOSE CAUSE HAS BEEN TOO LONG NEGLECTED.

PREFACE.

It has been stated that "Medicine is, very properly, conservative, for many new ideas are constantly being brought forward—often the result of immature speculation and without any scientific basis—and the physician must necessarily remain agnostic. But there is a distinct difference between fancy and fact, and if a new conception of the etiology or nature of a given disease is advanced, no matter how much that conception may deviate from the traditional teachings, if based upon scientific evidence and proof, it is not to be condemned simply because it upsets all previous conceptions and traditions." This statement could be very well expanded to include any new conception of practical treatment which is based upon scientific facts.

In preparing this volume the author has had two major purposes. *First*, to present to the medical profession in a more complete form the diagnostic and therapeutic value of non-surgical drainage of the biliary system and to show that this method is of value to the surgeon as well as to the physician. It is a distinctly new procedure which was introduced in September, 1919, after a period of two and a half years of quiet investigation into its merits at the hands of the author. He believes it to be based upon scientific principles that are soundly established. For three and a half years it has been subjected to very careful scrutiny by medical men throughout the country and has given rise to both favorable and antagonistic criticism. Today there is more general recognition of its value and the author has attempted to harmonize still further some of the few remaining discordant points of view.

This method of attacking the diagnostic and therapeutic problems of gall-tract disease is a distinct step forward. The great need is earlier and more complete recognition of gastro-intestinal or gall-tract disease in order to prevent late pathology. The methods presented will very greatly aid in securing this. When applied diagnostically, gall-tract drainage will often detect pathological physiology, the forerunner of actual disease. Therapeutically, its utilization will permit of discarding, to a certain extent, some of the dietetic and oral therapeutic measures which in the past have proved relatively unsuccessful, and when judiciously applied pre-operatively and postoperatively will secure for the gall-tract patient

a better chance of successful and total recovery from the operative procedure without danger of subsequent relapses. Many borderline cases, heretofore considered surgical, may now be successfully treated by this method.

The author points out its limitations. It cannot excise pathological tissue, or safely remove gall stones, or release adhesions. It can, however, materially aid the surgeon in the diagnosis of these conditions and can prepare the operative field with increased safety to the patient. Where the cystic duct is patulous it can drain the gall-bladder as well as can be done by the surgeon. Postoperatively applied it will aid in securing the recovery of the patient. Comparative tests have shown that this method can drain the gall ducts better *via* the duodenum than can be accomplished by the surgeon in draining through the abdominal wall and with less risk to the patient. Many cases who have had multiple gall-tract operations, and for whom all surgical resources have been exhausted, have been restored to health by utilizing this method. In the treatment of various diseases of the liver itself it has opened up an entirely new field of usefulness which has most promising future prospects. The author explains this in detail in the text and demonstrates the proof by various case reports.

The *second* major purpose is to present the author's plan of a systematic and practical method of studying the gastro-intestinal tract as a whole. This applies particularly to the chronic gastro-intestinal invalid for whom abdominal operative interference may be considered necessary. The patient with acute intra-abdominal disease has been surgically well taken care of, but the chronic gastro-intestinal invalid has been woefully neglected or mistreated. Such an invalid has too often in the past been called simply neurasthenic because of diagnostic incompleteness. The result has been that many such chronic cases, of equal or greater importance than the more acute forms, have been passed from physician to surgeon and back again, with often nothing accomplished, or indeed even disastrous results.

The author points out that in the subacute or chronic gastro-intestinal invalid it is possible to prove by the methods advocated that the patient has multiple zones of inflammation or infection, which, in turn, have affected other systems more or less related. Thus the final diagnosis usually shows that the condition is not simply one predominant state of disease, such as appendicitis, duodenal ulcer or cholecystitis, but very often combinations of these and other conditions, all of which must be appropriately treated. This is important evidence for the surgeon or internist to learn, and will often avoid multiple operations, and the more favorable cases can be restored to health without recourse to surgery.

The author has been at great pains to pay proper tribute to the accomplishments of the surgeon, but he believes that in a carefully selected group of cases the methods of treatment advocated may give equally good or better results, and with the avoidance of an operative risk which is never negligible. The results already accomplished have been demonstrated by the case reports submitted.

Certain primary gastric complaints of the chronic invalid will be proved after proper study to be really secondary sequelæ of primary disease in lungs, heart, kidneys, nervous and other systems. Many such cases should never be operated on, for with proper treatment of the heart or kidneys and topical treatment of the gastro-intestinal tract they will make good recoveries.

The great majority of cases of chronic organic gastro-intestinal and other systemic disease will be found to be the result of infection alone or of toxemia resulting from focal infection. The author emphasizes the importance of technical and topical treatment to accessible regions of the gastro-intestinal tract, together with the use of vaccines and other measures, in the effort to eliminate the secondary abdominal foci of infection. Such treatment should be undertaken only after proper search for and removal of all extra-gastric foci, especially those draining directly into the gastro-intestinal tract.

The author urges greater conservatism in the use of haphazard chemical therapy given by mouth and of irrational dietetic measures based upon guess work alone and with no scientific knowledge of the individual patient's gastro-intestinal chemistry or motility.

Finally, the author offers this volume, not as a text book, but as a treatise giving a general view of the subject. He has not presented the detailed technic for the performance of many of the customary diagnostic tests now used in gastro-enterology, since these can be found in many standard text-books. Instead he reviews the total subject in a broad way and calls attention to the more acceptable diagnostic tests and particularly urges the replacement of some of the older and more empiric methods by modern ones which rest upon a more substantial scientific foundation.

Much of diagnostic value to be found within the pages of this book is already well known, but presented from a different angle, and will bear much repetition. Some of the newer methods presented may prove to be desirable modifications of older ones, while a few are original ones devised by the author, which—after extended trial—he believes of sufficient merit to warrant publication.

The author is under great obligation to Dr. Henry J. Bartle and Dr. Richard T. Ellison, who have prepared and arranged the subject-matter of several chapters and have made many helpful suggestions in regard to the general construction of this book.

The author extends his very grateful thanks to Professors William Fitch Cheney, John A. Kolmer, Willis F. Manges and Olaf Bergeim, who have each contributed a chapter which lends additional value to this volume.

To Dr. A. D. Whiting is extended the author's thanks for the preparation of the index, which is such an important feature of any book.

To Mr. Erwin F. Faber the author extends his very appreciative thanks for the painstaking care with which he has applied himself to furnishing many illustrations, and particularly the water color plates which speak for themselves.

To the various members of his office staff the author expresses his thankful appreciation for their constant daily efforts which have made the collection of the detailed data prepared for use in this book a much easier matter. Over 200,000 items have been tabulated covering the study of 1104 patients with a total number of drainages amounting to 7593.

The publishers, Messrs. Lea & Febiger, have been most courteous and have been willing to undertake a somewhat unusual manufacturing expense in order to meet the wishes of the author, particularly in regard to the numerous illustrations and tables. The author particularly thanks Mr. William A. Hassett of the publishers' staff for certain suggestions involving the practical construction of this book.

Finally, the author desires to express to his personal secretary, Miss Mary G. Pennypacker, his very especial appreciation of her absolutely untiring devotion to the preparation of this volume. Without her constant assistance this book could not have been prepared in its present form.

B. B. V. L.

PHILADELPHIA, 1923.

INTRODUCTION.

MUCH of the advance in medical knowledge has been due to the discovery of technical methods of examination. Examples are many, such as the ophthalmoscope, the cystoscope, the stomach tube, the graphic records of the heart and the sphygmomanometer. In most of these the principle of the technical process itself is so comparatively simple that one wonders why it had not been discovered long before. But the possibilities which these methods suggest may be far from simple. They add to the complexity of our work but also to the accuracy of our diagnosis if properly used. To these may be added the technic of drainage of the gall-bladder and biliary tract through the duodenum. An observation of that wonderful investigator, Dr. S. J. Meltzer, was the basis of the practical method evolved and described by the author of this book.

Dr. Lyon gives us the result of a thorough study of his method of drainage of the biliary tract by way of the duodenum. How thoroughly this study has been done is evident by the records submitted. The possibilities of this method are so far-reaching, both in diagnosis and treatment, that much has to be included in a full presentation of the subject and to carry through the argument in proper form. Many points relating to the liver and gall-bladder are included. This adds to the size of the work but also much to its value and interest. In addition he has discussed many points and given valuable suggestions bearing on the general subject of the diagnosis and treatment of chronic gastro-intestinal diseases. There is a large group of patients with chronic disease of the digestive tract in whom both diagnosis and treatment are difficult. There is much in this book concerning them which is of value both to the internist and surgeon.

Any new procedure must be subjected to careful investigation and criticism. Much misunderstanding arises because some do not take the trouble to understand accurately what is said and attribute to the one who introduces something new, claims which he never made. Another difficulty is that some men are not willing to make the necessary effort to follow directions carefully. The technic of biliary drainage as required for accurate diagnosis is not simple and requires time and patience—which some are unwilling to give. Such

are not justified in passing judgment. This requires emphasis as criticisms have been passed on the method by men who had not done it properly.

There may be discussion and difference of opinion as to the theory of the process but, whatever be the final outcome of that, the fact stands out that we have in the method "a practical procedure" as Dr. Lyon states. I do not see how any one can study this method when properly carried out and not appreciate its value. The indications for its employment are carefully given by Dr. Lyon. He does not claim, as some have suggested, that it is to supersede all other methods of investigation and therapy in hepatic, gall-bladder, and bile duct disease. On the contrary, for certain cases, he offers the method only as an alternative or auxillary therapeutic procedure, and gives numerous examples of its value when properly applied. The results in the first patient in his series (reported as Case I, page 501) were to me a most convincing demonstration. No more difficult problem could have been chosen on which to try a new method and as one of the many who had tried to help the patient and failed, I followed her progress from chronic invalidism to sound health with particular interest. I know of no other method by which this result could have been accomplished.

The reports of cases (pages 501 and after) should be studied carefully for they illustrate many of the difficulties in diagnosis and decision as to treatment. The discussion of possibilities and of what the results might have been if other treatment had been adopted is most instructive. Emphasis should be placed on the fact that this method is of advantage to the surgeon as well as to the internist. In diagnosis, in the preparation for operation and in the management after operation, the surgeon will find that much can be gained by the use of non-surgical biliary-tract drainage.

Many of the problems connected with hepatic function and disease are for the future to solve and much help will come from this method. In diagnosis and treatment its value has been proved but more than this, as is emphasized by Dr. Lyon, it offers possibilities for the prevention of disease which in the future may prove to be its greatest value.

THOMAS McCRAE.

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NON-SURGICAL DRAINAGE OF THE GALL-TRACT.

CHAPTER I.

EMBRYOLOGY, HISTOLOGY AND ANATOMY IN RELATION TO BILIARY TRACT DISEASE.

EMBRYOLOGY.

A BRIEF review of the embryology, histology and anatomy of the duodeno-pancreatic zone is given here, so that a better understanding of the pathology of this region, and the applied anatomy, too, may be acquired. Many of us feel that anatomy is one of the subjects that we can best afford to forget, and that, while it may be an essential for the successful practice of surgery, it plays no conspicuous part in medicine. This is not so; for the astute internist should have more than an indifferent knowledge of anatomy and histology to properly interpret symptoms, signs and microscopical findings.

Only the important points are cited here to refresh our memories of these facts, and no endeavor has been made other than to review the high lights of the subjects.

To begin with, in the fertilized egg, there first develops the primitive streak which is the first evidence of the budding embryo. Various germinal layers then become evident, the ectoderm, the mesoderm and the entoderm.

During the very earliest hours in the development of the embryo these various layers behave in a remarkable and rapidly kaleidoscopic way. The *ectoderm* spreads out over the surface of the developing embryo and, through the process of infolding, segmentation and reflection, it provides various structures: epidermis and its appendages, nails, hair, sebaceous glands, sweat glands, and their involuntary muscles; the mucous membrane of the nose, sinuses, mouth and the salivary glands; enamel of the teeth; the nervous system; lens and retina of the eyes; epithelium of the internal ear, and part of the pituitary and pineal bodies.

The middle germinal layer (*mesoderm*) divides into two secondary lamellæ, the somatopleure and the splanchnopleure. The somatopleure unites with the ectoderm, while the splanchnopleure unites

with the entoderm (the innermost of the three layers); and as these two layers develop there is formed a cylinder within a cylinder united at the back, and the space between the two, lined with endothelium, becomes the thoracic (pleural) cavity, above, and the

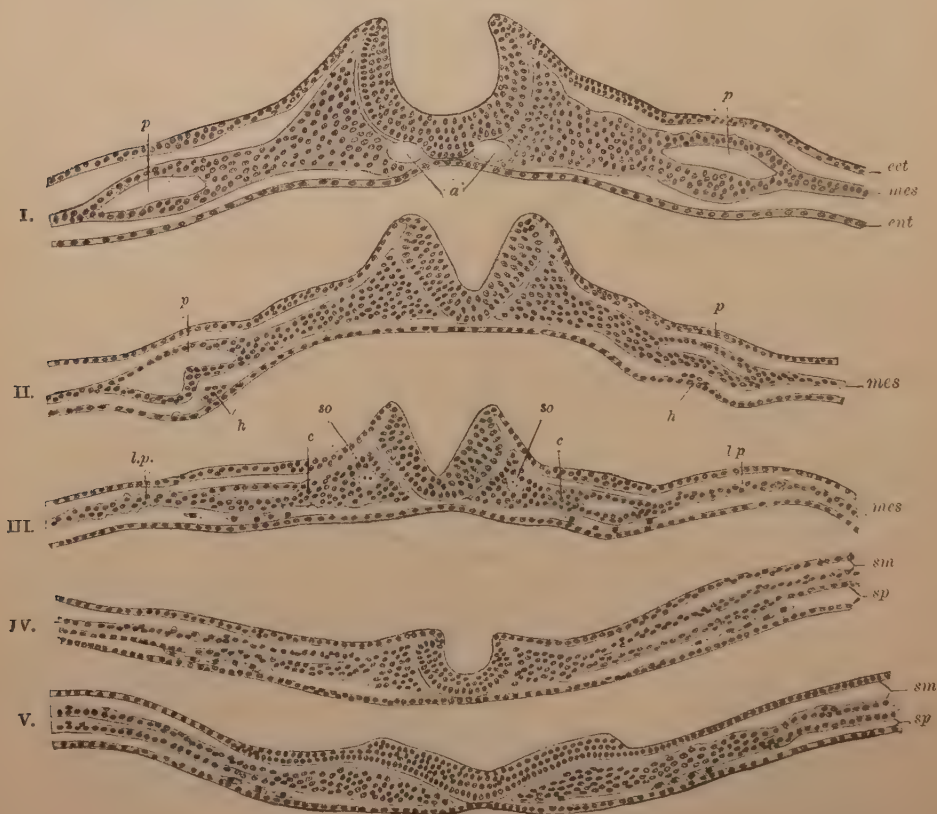


FIG. 1.—A series of transverse sections through an embryo of the dog. (After Bonnet.) Section I is the most anterior. In V the neural plate is spread out nearly flat. The series shows the uprising of the neural folds to form the neural canal. *a*. Aortæ. *c*. Intermediate cell mass. *ect*. Ectoderm. *ent*. Entoderm. *h*, *h*. Rudiments of endothelial heart tubes. In III, IV, and V the scattered cells represented between the entoderm and splanchnic layer of mesoderm are the vasoformative cells which give origin in front, according to Bonnet, to the heart tubes, *h*; *l. p.* Lateral plate still undivided in I, II, and III; in IV and V split into somatic (*sm*) and splanchnic (*sp*) layers of mesoderm. *mes*. Mesoderm. *p*. Pericardium. *so*. Primitive segment. (Gray.)

abdominal (peritoneal) cavity below; later transversely divided by the diaphragm (derived in part from the septum transversalis).

From the mesoderm, the following structures are developed: the connective tissues, voluntary and involuntary muscle; the vascular

and lymphatic systems with the blood and lymph corpuscles; the spleen; the reproductive organs; and the kidneys and ureters.

The innermost layer, the *entoderm*, by folding forward and uniting ventrally each fold to the other, forms the lining of the inner cylinder referred to above. From it are derived the epithelium lining the gastro-intestinal tract beginning at the pharynx (the epithelium of the mouth comes from the ectoderm) and extending to the anus; the secreting cells of the liver and pancreas, as direct outgrowths

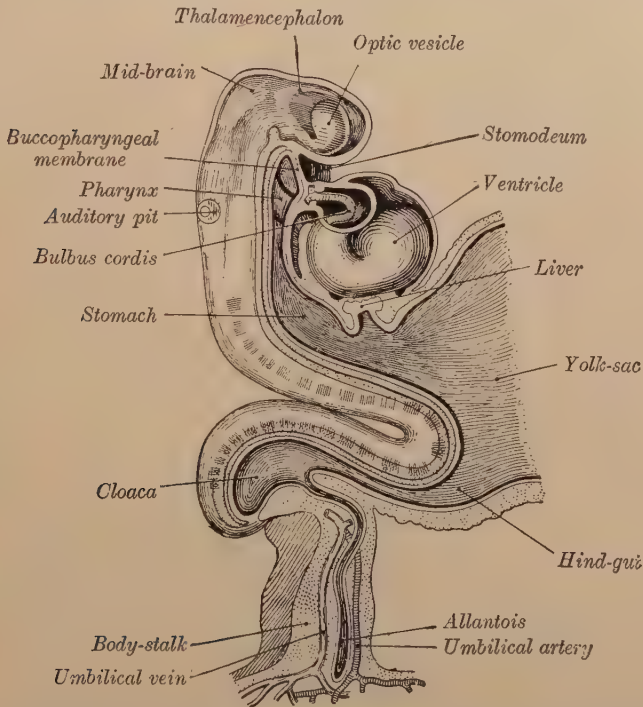


FIG. 2.—Human embryo about fifteen days old. Brain and heart represented from right side. Digestive tube and yolk sac in median section. (After His.)

of the epithelial lining. (The stroma of these organs is derived from the mesoblastic tissue of the septum transversalis.) Also, it supplies the epithelial lining of the respiratory tract; the thyroid and thymus; the bladder, urethra in the female and the prostatic urethra and prostate in the male.

We are chiefly concerned, however, with development of the central part of the digestive tube, which, as we have seen above, has the entoderm providing its lining and the splanchnopleure of the mesoderm forming its muscular walls and peritoneal coverings.

At first this is just a straight tube connecting with the umbilical vesicle by the vitelline duct, but by a closing off process this duct

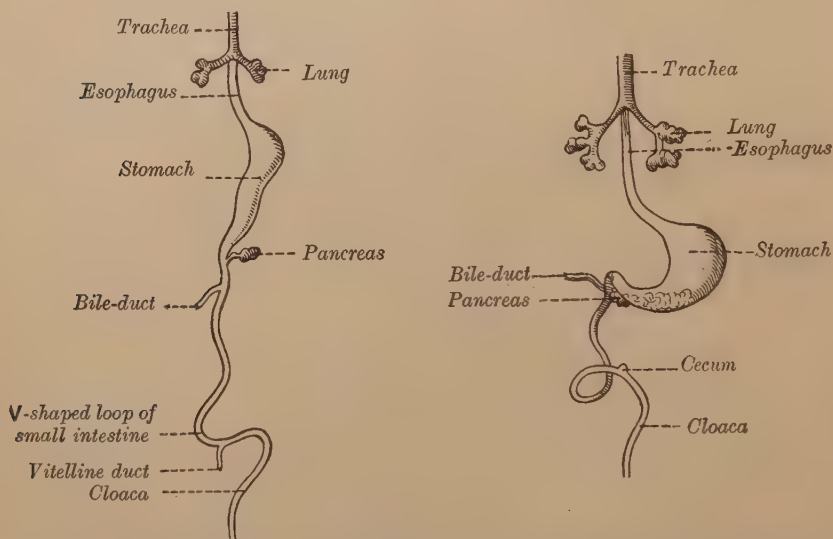


FIG. 3.—Front view of two successive stages in the development of the digestive tube. (His.)

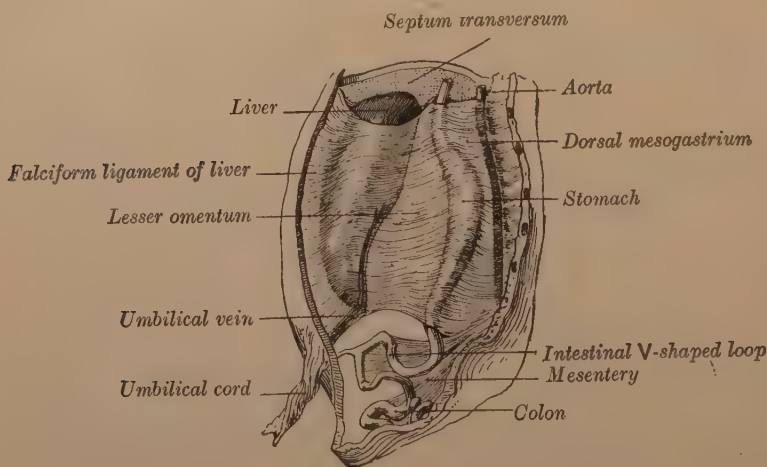


FIG. 4.—The primitive mesentery of a six weeks' human embryo, half schematic. (Kollmann.)

becomes atrophied to a fibrous cord. In some cases the duct may remain as a portion of the small bowel, and is then known as Meckel's

diverticulum, a blind pouch one or more inches in length springing from the lower portion of the ileum. This straight digestive canal is at first attached to the posterior wall of the abdomen by the reflection of the peritoneum which forms a primitive mesentery through which the bloodvessels, lymphatics and nerves reach the primitive gut tract.

The upper part of the tube (the esophagus) remains relatively the same; but below the diaphragm the tube becomes bulged backward as the greater curvature of the stomach makes its appearance,

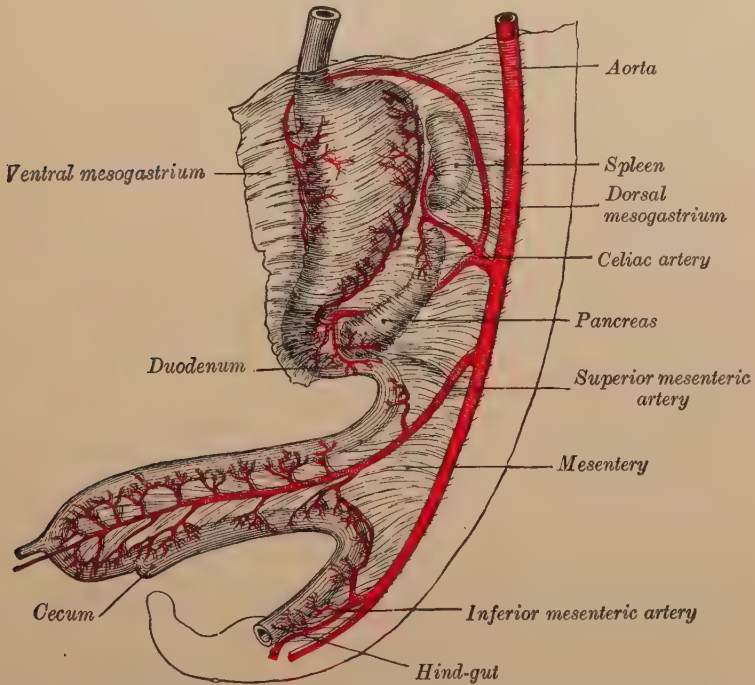


FIG. 5.—Abdominal part of digestive tube and its attachment to the primitive or common mesentery. Human embryo of six weeks. (After Toldt.)

while the muscle at the lower end of the stomach develops into a sphincter, the beginning pylorus. A short distance below the pylorus anteriorly, four out-buddings appear, derived from the epithelial (entoderm) tissue of the duodenum. The first two of these to appear are the liver anlagen and the third and fourth are the anlagen of a part of the future pancreas, one of which develops into that portion known as the head. The other disappears or fuses with the bile ducts. Posteriorly another pancreatic anlage develops and this later becomes the body and the tail, and although this constitutes

the larger portion of the gland, its duct atrophies and usually becomes obliterated, remaining in about 25 per cent of the cases as the duct of Santorini. The duct of the anterior pancreatic anlage remains as Wirsung's duct, and in 75 per cent of the cases it becomes the important duct of the pancreas, after fusion of the two portions (posterior and surviving anterior) of the pancreas occurs. This complicated origin of the pancreas, with its intimate association with the birth of the liver, explains the many abnormalities that are found in the unions of these two glandular (liver and pancreatic) ducts at their entrance into the duodenum (ampulla of Vater) (13). (See Fig. 37).

The two liver anlagen unite and together make the whole organ, one developing into the right lobe and the other into the left. As a rule their two ducts unite in a common duct, from which the cystic duct later develops; but where they remain as separate ducts the

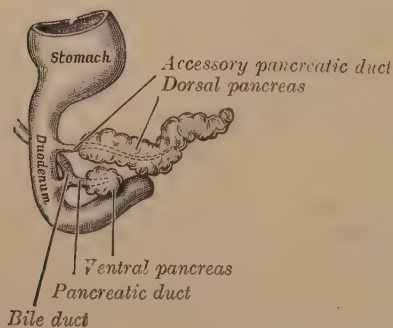


FIG. 6.—Pancreas of a human embryo of five weeks. (Kollmann.)

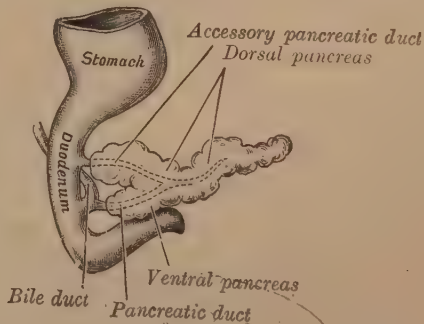


FIG. 7.—Pancreas of a human embryo at end of sixth week. (Kollmann.)

cystic duct will be seen to empty into the right hepatic duct (1). With the growth of the glandular substance, buds from the umbilical vein make their appearance in the septum transversalis, and accompany the ducts in all their various ramifications through the glandular cells. This is the future portal vein system of the liver.

With the growth of the liver up under the diaphragm the stomach becomes displaced downward and rotated on its long vertical axis, so that the posteriorly bulging greater curvature is first pushed to the left, and later, downward, and the original left side of the stomach becomes the anterior wall while the right side becomes the posterior wall.

The peritoneal reflection from the greater curvature to the posterior wall of the abdomen (primitive mesentery) sags downward to make a pouch, and thus forms the gastro-splenic and great omentum, which later fuses with the superior layer of the trans-

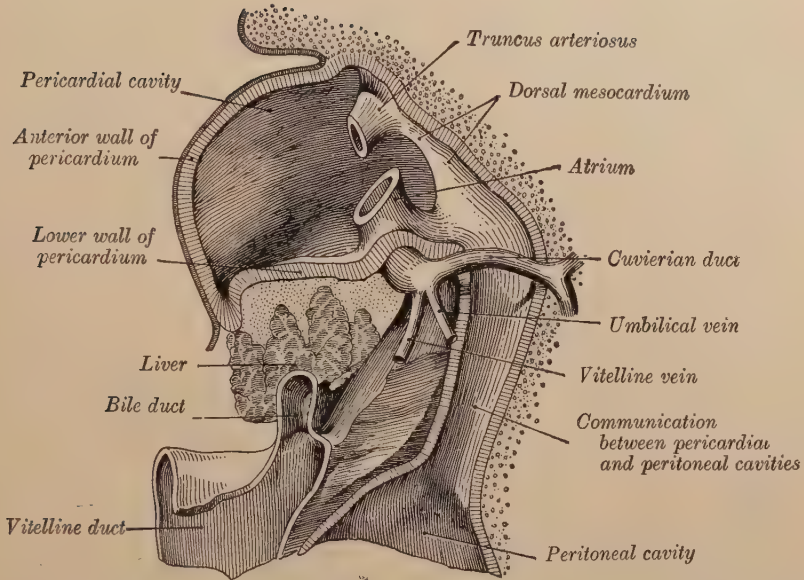


FIG. 8.—Liver with the septum transversum. Human embryo 3 mm. long. (After model and figure by His.)

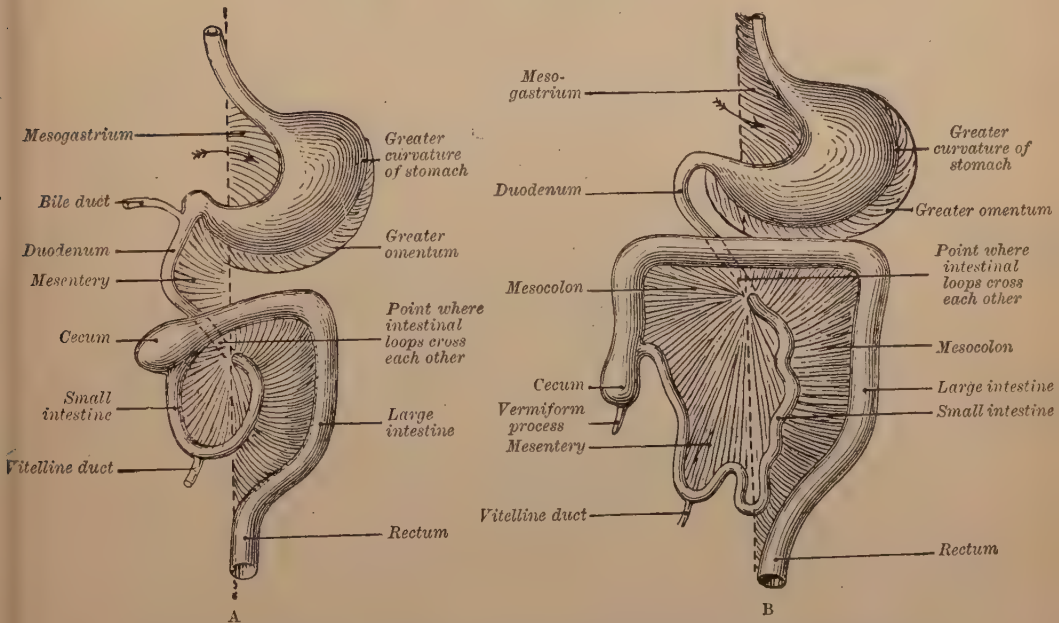


FIG. 9.—Diagram to illustrate two stages in the development of the digestive tube and its mesentery. The arrow indicates the entrance to the bursa omentalis. (Gray.)

verse mesocolon. The upward growth of the liver also distorts the original straight duodenum and rotates it on its long vertical axis toward the right, and whereas the liver with its ducts primarily grew out from the anterior face of the duodenum, when development is complete, we find the ducts entering the duodenum from behind. Coincident with this, the anterior anlage of the pancreas has also been dragged around the *right* side of the duodenum, and later this portion becomes fused from below with the posterior pancreatic anlage.

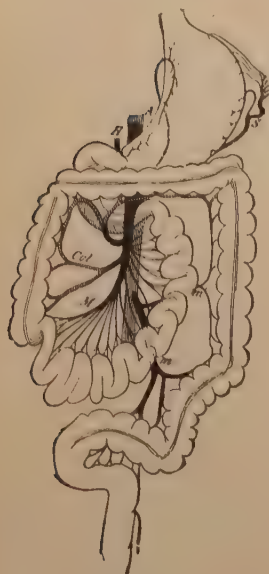


FIG. 10

FIG. 10.—Final disposition of the intestines and their vascular relations. (Jounesco.) A. Aorta. H. Hepatic artery. M. Col. Branches of superior mesenteric artery. m, m'. Branches of inferior mesenteric artery. S. Splenic artery. (Gray.)

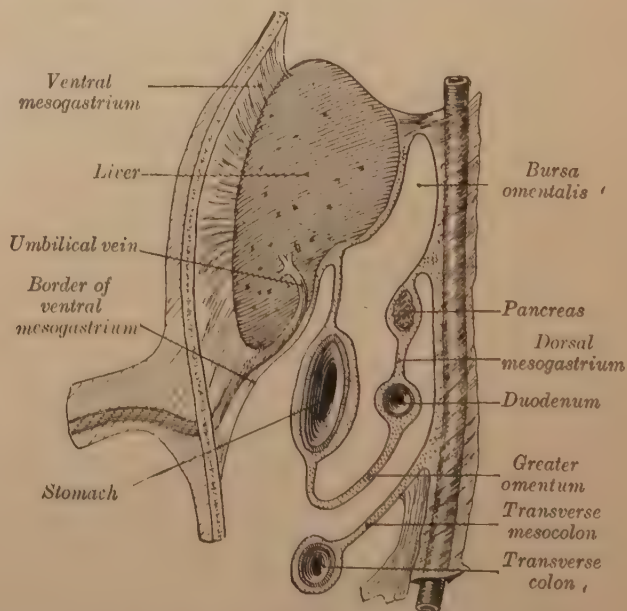


FIG. 11

FIG. 11. Schematic figure of the bursa omentalis, etc. Human embryo of eight weeks. (Kollmann.)

You will recall that the duodenum was covered with peritoneum when these hepatic and pancreatic out-buddings began, so that, as they grew larger and larger they were still covered by peritoneum. So, as the liver grew up under the vault of the diaphragm, while the pancreas was being tucked in posterior to the stomach and duodenum, this peritoneum was being dragged along with these organs, and thus the interesting anatomical relations around the foramen of Winslow were brought about, and the *lesser* peritoneal cavity was established by the downward pouching of the primitive mesen-

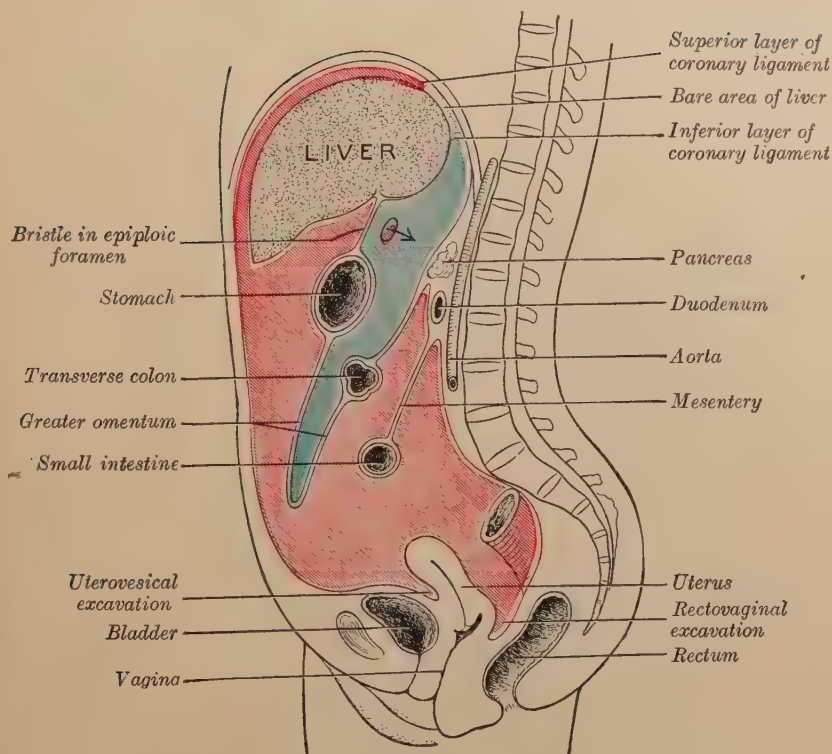


FIG. 12.—Vertical disposition of the peritoneum. Main cavity, red; omental bursa, blue. (Gray.)

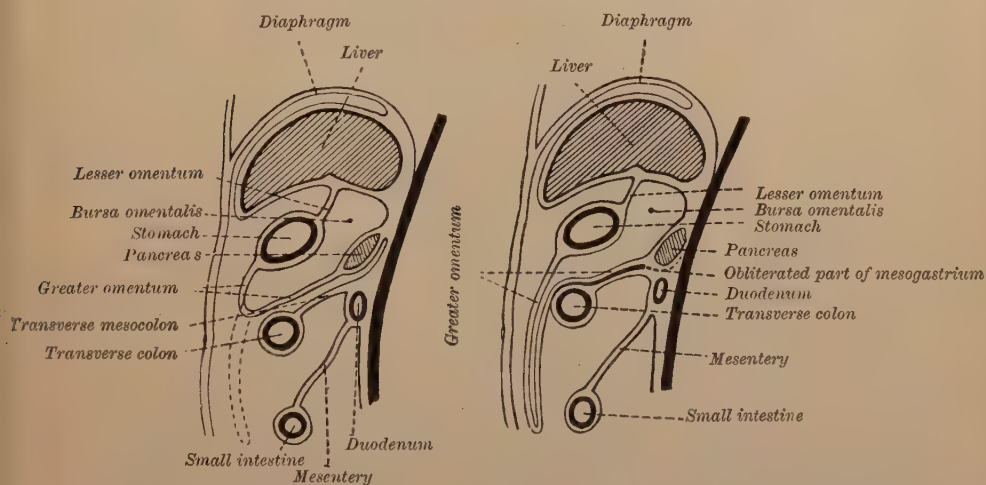


FIG. 13.—Diagrams to illustrate the development of the greater omentum and transverse mesocolon. (Gray.)

tery attached to the greater curvature of the stomach. The posterior peritoneal covering of the pancreas became absorbed, and

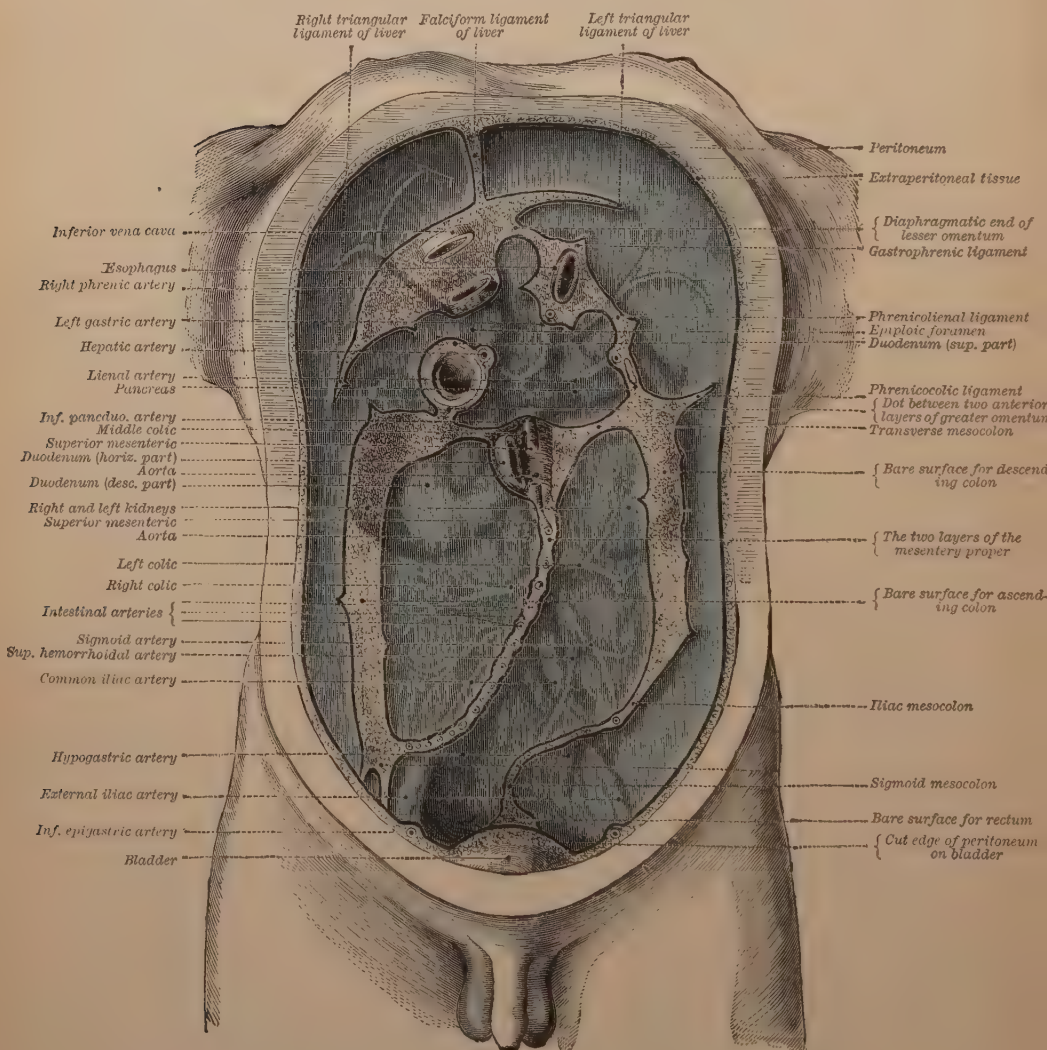


FIG. 14.—Diagram devised by Delépine to show the lines along which the peritoneum leaves the wall of the abdomen to invest the viscera. (Gray.)

we see it as a retroperitoneal organ. Part of the peritoneum dragged upward by the growth of the liver became atrophied where it underlay the diaphragm, and other portions became the various ligaments

of the liver and the gastro-hepatic omentum. The posterior peritoneal covering of the duodenum in part became atrophied and, as a result, in its descending and ascending portions this organ is now retroperitoneal.

Beyond the duodenum, the small bowel, except for its growth in length, remained unchanged and retained the original plan of peritoneal architecture (its mesentery) with which it started, except that with the growth of the large bowel the whole mesentery underwent a twist so that what was once the left face of the mesentery is now the right. This occurred in this way. With the rapid growth

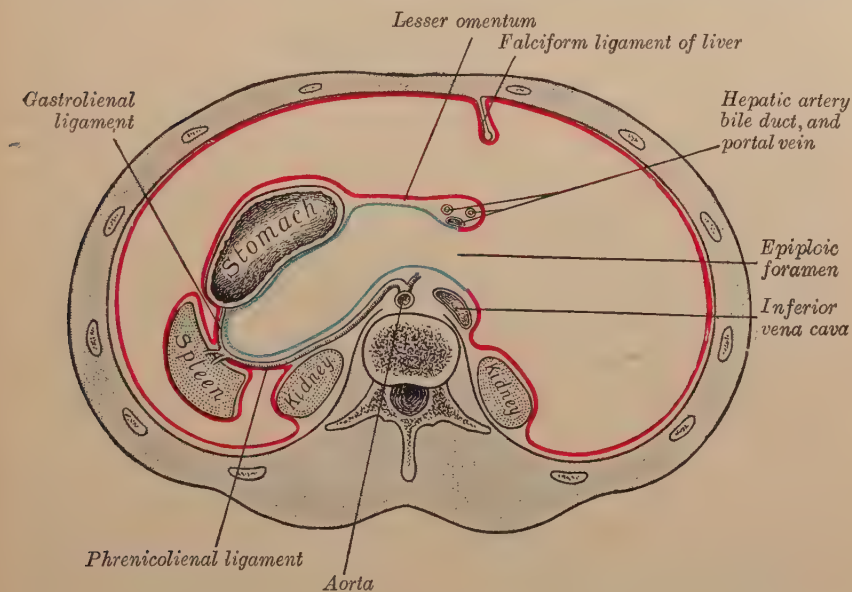


FIG. 15.—Horizontal disposition of the peritoneum in the upper part of the abdomen. (Gray.)

of the liver, before the abdomen became completely closed in its ventral aspect, the bowels were relatively extra-abdominal organs. With the growth of the liver accomplished, the intra-abdominal space became greater because of the growth of the body. Coincident with the closing in at the umbilical region of the ventral wall, the small bowel first returned and was followed by the large gut, which remained along the left side of the abdominal cavity. With increased growth the cecum and its distal bowel then took up the position of the present transverse colon, and later migrated down along the right abdomen to the position now occupied by the ascending colon. Thus the terminal ileum was in due course carried through a full

half turn from the left lower quadrant into the right lower quadrant, and with it went its mesentery as well as that attaching to the rest of the bowel (jejunum). Then fixation of the ascending and descending portions of the colon occurred whereby they lost their mesentery; and the transverse colon and sigmoid, because of the greater motion required of these organs, retained their mesentery. Fusion of the superior layer of the transverse mesocolon with the peritoneum of the stomach resulted in the formation of the gastro-colic omentum, and thus the one primary peritoneal cavity became two, the greater and the lesser, so that the posterior wall of the stomach now is in the lesser of the two peritoneal cavities, and the foramen of Winslow affords the only communication between the two.

HISTOLOGY.

No attempt will be made to go into the complete histology of the various digestive organs and glands, which, although interesting, yet from the standpoint of diagnosis is unimportant in a work such as this. We are interested in those histological elements that must be recognized by the aid of the microscope and differentiated as coming from the mouth, esophagus, stomach, duodenum and gall-tract. These elements are the exfoliated cells of the lining membrane of these organs and their secretions (mucus and bile), as well as certain extraneous cells, such as the salivary, red and white blood cells, which we often withdraw through the tube. It is important to remember that what we may see in a microscopical field of stomach contents may have come either from above by swallowing (nose, mouth, bronchial tree and esophagus), or from below by regurgitation (duodenum, pancreas or liver); and one microscopical slide may show elements from all the regions named. We must remember, too, in studying the cells which we remove from the stomach and duodenum that they may have been desquamated perhaps a long time before, and that not only has death very probably taken place, but that a certain amount of digestion of the cells may have already occurred. Again, it is to be remembered that the action of the various chemical substances introduced in lavage of the stomach, in our endeavor to cleanse and disinfect the stomach, may have had some altering effect on their morphology. And, again, in bringing about a biliary tract drainage, the hypertonicity of the stimulating solution is to be remembered, and due regard given for the effect on the cells of these solutions (osmosis).

These facts are mentioned because the cells, as you will view them, will frequently deviate materially in form from the cells that have been hardened and stained in the usual way by taking a segment of

the gut tract at autopsy and subjecting it to the various laboratory procedures before mounting for examination.

The importance of *immediately* making our microscopical examination of the material withdrawn at biliary drainage must be mentioned, for in most of the specimens digestion is progressing within the bottle, and even on the slide prepared for microscopical study; and *in less than an hour the contour of the cells may be completely lost*.

In describing the various cellular elements withdrawn from the stomach and duodenum by means of the tube, we will proceed in anatomical order from the mouth downward. By referring to the various drawings which illustrate practically all of the various cells, drawn to the same scale (a magnification of 385 diameters) you will perhaps obtain a better idea of the microscopical picture of these histological elements than by a word description.

The cells that are swallowed comprise those coming from the nose and nasopharynx (ciliated columnar epithelium, goblet cells and stratified squamous cells and lymphoid tissue); from the mouth (squamous cells of the buccal stratified epithelial lining membrane, the various sized epithelial cells from the tongue, and the so-called salivary corpuscles); from the bronchial tree (mainly ciliated columnar epithelium, alveolar cells and perhaps the so-called Herzfehler cells); and, lastly, those from the esophagus (stratified squamous epithelium). Besides these, of course, you may find pus cells and red blood corpuscles that have been swallowed, and have come originally from any one or more of the sources named above.

The *ciliated columnar cells* may be found isolated or in a row, which group may contain a mucous goblet cell. Usually the cell is narrow, and, with fine focussing, you may see the fine, hair-like processes mounting the squared regular top or exposed portion, which is the shortest side of this cell. The longer sides may be irregular, gradually meeting in conical fashion, or, after continuing parallel they may unite after forming an attenuated end similar to the stem of a goblet. Indeed, some of these cells resemble this vessel so closely that they have been called *goblet cells* when the ciliated end has been replaced by an ostium and the body of the cell is distended with mucus. In both of these cells the nucleus is oval and deeply placed with respect to the surface end of the cell.

The most common cell met with is the *buccal squamous epithelial cell*. This is the largest cell you will find in the field. When recently desquamated it has a very regular and distinct outline, with a clear or finely granular protoplasm containing a large oval nucleus. This cell presents the appearance of a large thin scale. The *cells from the deeper layers* of this stratified squamous epithelial mucus membrane, while they are generally of the same type, are smaller and are irregu-

larly polyhedral or irregularly columnar, with an oval nucleus placed toward one end.

The so-called *salivary corpuscle* is very definitely circular in outline, and has a distinct nucleus and many dark granules within its protoplasm. It reminds one of the acido- or eosinophil, but is somewhat larger. It is very similar to the cell sometimes referred to as the *heart failure* or "Herzfehler" cell obtained from the respiratory tract in the sputum. It is thought to be an escaped lymphoid cell from the adenoid tissue of the mouth, which has become swollen in consequence of the action on it of the saliva. (7)

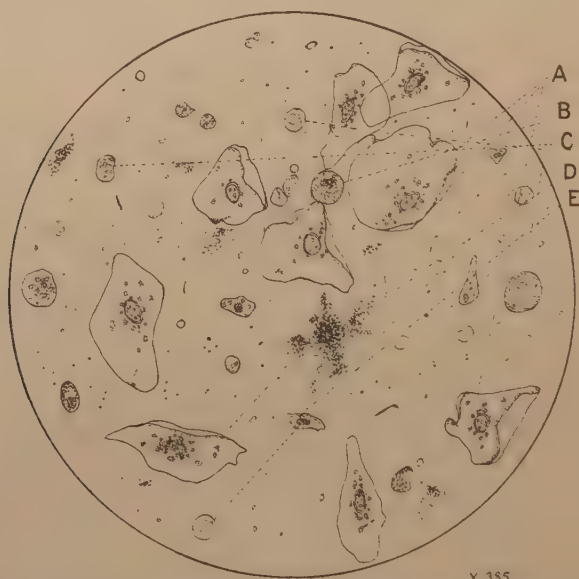


FIG. 16.—Gastric subacidity, with extragastric cytology. A, respiratory and buccal epithelial cells; B, salivary corpuscles; C, leukocytes or pus cells with protoplasm intact; D, colony of cocci; E, occasional gastric epithelial cells.

The *alveolar epithelial cell* is an irregularly rounded cell four or five times the size of a white blood corpuscle, and contains one nucleus or more. There are frequently inclusion bodies observed, and these consist of carbon granules, myelin and fat droplets, bacteria and blood pigments. On the warm stage they may exhibit ameboid motion, and might be mistaken for the various types of amœbæ.

After reaching the cardiac orifice of the stomach the source of all squamous epithelium has been left behind. From here until the anal opening is reached, and including the various duct systems

(pancreatic and biliary) that drain their contents into the bowel, every bit of the mucous membrane is covered by *simple columnar epithelium* (except the duodenum, which seems, in fresh specimens, to furnish an *ovoidal or cuboidal epithelial cell*).

In the stomach the mucosa is thrown up into ridges or folds (*rugæ*) and the openings of the gastric glands are seen as minute depressions. These are tubular glands and with their surrounding stroma make up the bulk of the mucosa (*tunica propria*), beneath which are found the *muscularis mucosæ* and the *submucosa*. The whole is covered over with a surface layer of *columnar epithelium*.



FIG. 17.—Gastric epithelial cells, unbilestained. Note tendency to irregularity in shape, more centrally placed nucleus, goblet cell appearance and forked tails. X 385.

which at the orifice of the gland openings gradually changes its form into cells more *spherical* in contour. The gastric glands are of two types: the *peptic glands* found in the proximal two-thirds of the stomach, and the *pyloric glands* found in the pyloric portion of the stomach.

The peptic glands are made up of *pyramidal and cuboidal cells*. These cells are arranged in two very definite ways in making up the structure of these tubular glands. Lining the canal or lumen of the gland, and concerned with the elaboration of pepsinogen, are the *chief or central cells*; while surrounding this central core of cells

we find the scattered *parietal* or *acid cells* which elaborate the hydrochloric acid. The *central cells* are irregularly columnar, and are rarely seen intact, as they undergo rapid digestion when shed, and usually only the nucleus with an attached shred of protoplasm is found. The *parietal cells* are triangular or polygonal in shape, with a round or oval nucleus, in a slightly granular protoplasm, and are somewhat more resistant to digestion. However, you will rarely need to differentiate between these two types, as it will be mostly the true columnar surface cell that you will see, unless astringents are used to cause the crypts to squeeze out their contents.

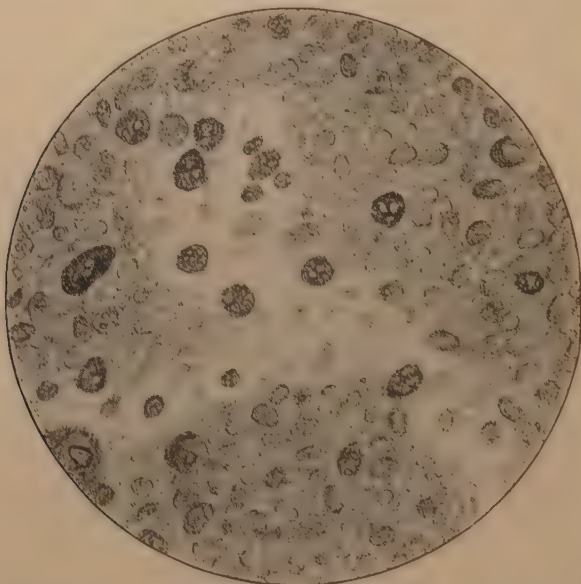


FIG. 18.—Unile stained duodenal cells and pus cells showing tendency to vacuolization. Note the fact that the cells are oval or cuboidal rather than columnar. $\times 385$.

The pyloric gland is a compound tubular gland and lined with *columnar epithelium* becoming cuboidal and triangular in outline in the deeper recesses of the gland, and is said to secrete a thin albuminous fluid (proferments) and not mucus (7), which is elaborated by the goblet or beaker cells of the surface epithelium.

On passing the pylorus these pyloric glands sink deeper into the submucosa and become the glands of Brunner, while the mucosa proper or tunica propria is occupied by the *simple tubular glands* of Lieberkühn. These glands of Lieberkühn are formed by the *columnar or cylindrical cells* of the surface epithelium which spread

downward into the crypts to become spherical in outline, just as in the stomach the surface epithelium takes on a slightly different form as it becomes specialized to acquire a definite glandular secreting function. Likewise the surface epithelium forms the *mucous goblet cells* of the tubules.

The mucosa of the duodenum is thrown into ridges (*valvulæ conniventes*) and smaller folds (*rugæ*) and the *whole is* minutely studded with myriads of tiny tufts (*villæ*) which contain the absorptive lymph vessel (*lacteal*). Over all of this spreads the surface layer of *columnar, ovoidal or cuboidal epithelium*.

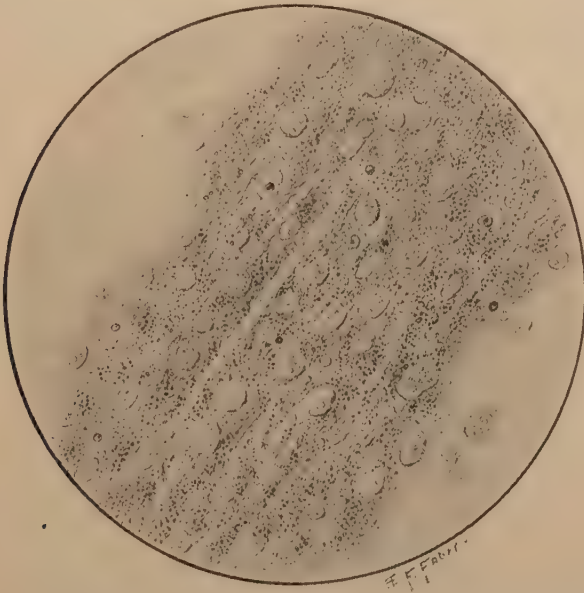


FIG. 19.—Band of duodenal mucosal epithelium in first stage of degeneration with multiple vacuoles and inclusion bodies and tendency of cell membrane to rupture, depositing granular débris. $\times 385$.

Within the biliary and pancreatic ducts and the gall-bladder, the mucosal surface is also covered by *simple columnar epithelium* with mucous goblet cells interspersed.

You will say, if all of this area (duodenum, bile ducts and gall-bladder) is lined with a mucous membrane of simple columnar epithelium, how are we to differentiate the source of the cells which we see in the microscopical field of fluid removed by our drainage? In general the cells exfoliated from the *duodenum* are ovoid or cuboid in outline, larger than a white blood corpuscle, and are rarely bile stained. Those coming from the *bile ducts and gall-*

bladder are typically columnar in outline, and are bile stained. Those from the *gall-bladder* are the tallest of any of the columnar cells that we see, are always deeply bile stained, and are frequently arranged in beautiful fan-like fashion, or clusters. By reference to the illustrations of microscopical fields you will see most of these cells depicted except in regard to color.

We have still much to learn to recognize and interpret in regard to the histology of the living or recently dead cells of the gastro-duodeno-biliary tract, as contrasted with our views of the histology of this tract determined by the usual fixation and hardening methods used in handling dead house specimens. But by dint of patience we are learning.

For a further description of the cytology of this tract see pages 320 to 325.

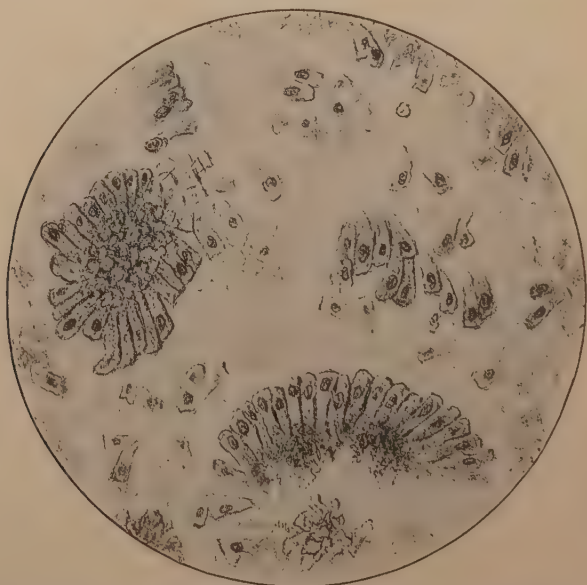


FIG. 20.—Heavily bile stained tall columnar epithelium from gall-bladder. Note arrangement of cells in fan shaped masses and clusters. Cells fairly well preserved with retained nuclei and comparatively little degeneration of cytoplasm. $\times 385$.

ANATOMY IN RELATION TO BILIARY-TRACT DRAINAGE.

The passage of the duodenal tube tip through the mouth, fauces, pharynx and *esophagus*, is a manual procedure from the operator's standpoint; and while it may be aided, on the part of the patient, by the act of swallowing, this is not absolutely necessary for the successful passage of the tube. With the exception of stricture and neoplasm or of compression of the *esophagus* from extraneous tumor,

aneurism, pleural or pericardial effusion; esophageal diverticulum and dilatation; or impacted foreign body, there is no anatomical difficulty in reaching the cardia. Here, we rarely find obstruction to the passage of the tip, and when we do, the anatomy may still be normal, but the physiology faulty. Cardiospasm may be present, and is said to be due to over activity of the circular constricting muscular ring of esophageal tissues at the opening into the stomach from the esophagus. But some authors have described an actual hypertrophy of this ring of muscular tissue such as is seen in congenital hypertrophic pyloric stenosis; and, again, others have attributed obstruction at the cardia, to compression of the lower end of the esophagus (where it bends at almost a right angle to the leftward to enter the stomach) by the crura of the diaphragm which may be in a temporary state of tonic contraction.

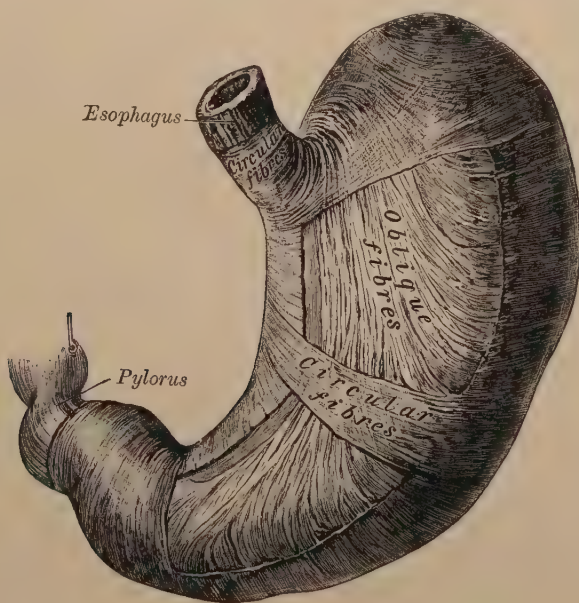


FIG. 21.—The oblique muscular fibers of the stomach, viewed from above and in front. (Spalteholz.)

The Stomach.—The anatomy of the stomach need not be gone into in detail, except to refresh our memories as to structure and relations, and to recall a few pathological features that may offer obstruction to the passage of our tube.

The *mucosa* is somewhat honeycombed and cryptic (tripe like) and provides an easy lodging place for many small particles of food; which fact must be borne in mind when interpreting our washing

of the overnight fasting stomach. Underlying the mucosa we have the *submucosa* with its network of arteries, veins, nerves and lymphatics, and beneath this the three layers of muscular fibers, an inner oblique, a middle circular, and an outer longitudinal layer.

The *muscular coat* is thinnest above at the fundus, and becomes thicker as we pass down over the body of the stomach, and is thickest at the antrum and pyloric regions. At this latter point the circular fibers become grouped in ring-like fashion, and form the pyloric sphincter. Outside of the muscular coats the whole stomach is covered with *peritoneum*, except where it is reflected to contiguous organs to form the so-called ligaments or omenta of the stomach.

The stomach was formerly thought to occupy a transverse *position* in the upper abdomen, but we now know that it is frequently vertical in position when not obliquely placed from an upper left

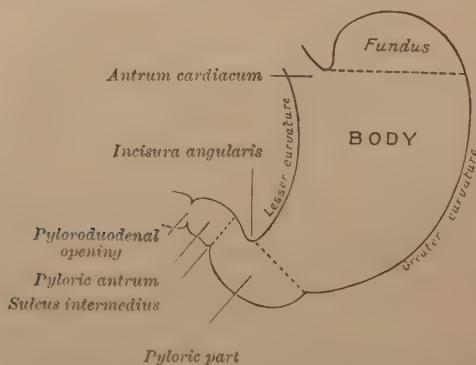


FIG. 22.—Outline of stomach, showing its anatomical landmarks. (Gray.)

to a lower right direction in the epigastrium. When well distended it extends to well below the umbilicus, and its only fixed point is the cardiac end. In extreme cases of ptosis even this may descend along with the diaphragm and heart. So that we can only roughly say that the stomach occupies a position in the upper left quadrant of the abdomen.

It is attached above to the liver by the lesser omentum, or gastro-hepatic ligament. This is a thin, veil-like structure, made up of two layers of peritoneum, which leave the stomach at the lesser curvature and pass to the transverse fissure of the liver, then backward along the fossa for the ductus venosus, where they leave the liver to embrace the lower end of the esophagus. To the left the stomach is attached to the spleen by a portion of the great omentum, the gastrosplenic ligament. Behind, at the cardiac end of the stomach it is fixed to the diaphragm by the gastrophrenic ligament. Ante-

riorly, the gastrocolic omentum is that portion of the great omentum which springs from the whole greater curvature of the stomach which has become adherent to the transverse colon.

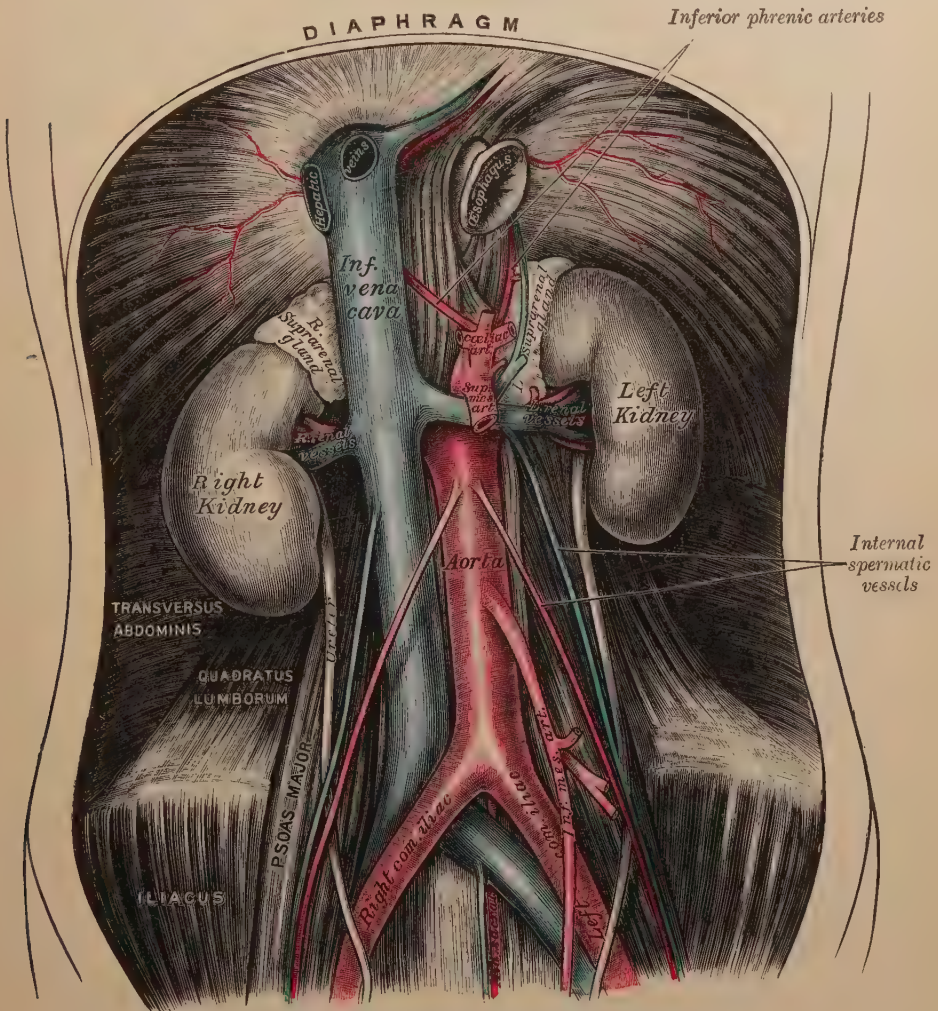


FIG. 23.—The abdominal aorta and its branches.

The relations of the stomach. Above and forward are the diaphragm and anterior abdominal wall, and the left and quadrate lobe of the liver. Posteriorly and below the stomach rests on a so-called bed made up of the diaphragm, pancreas, spleen, the left suprarenal gland, and the upper anterior surface of the left kidney, the trans-

verse mesocolon, and the splenic flexure of the colon. These organs thus form the boundaries of the lesser peritoneal cavity.

The *arterial supply* of the stomach is delivered from the celiac axis. Along the lesser curvature course the right and left gastric arteries, while along the greater curvature run the right gastroepiploic (a branch of the hepatic) and the left gastroepiploic and branches from the splenic artery.

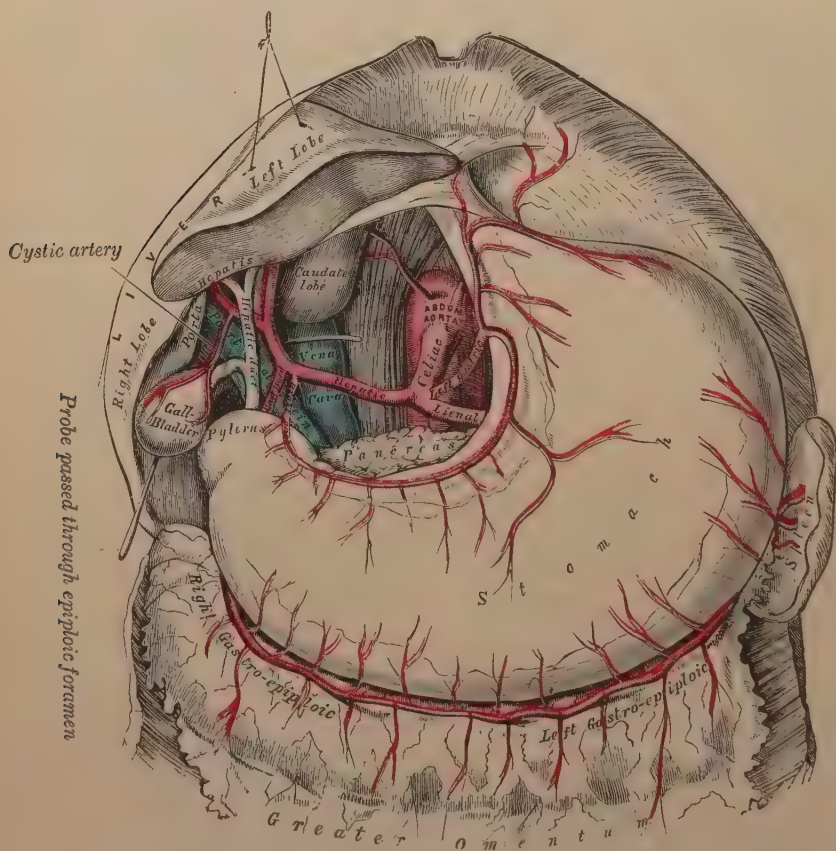


FIG. 24.—The celiac artery and its branches; the liver has been raised, and the lesser omentum and anterior layer of the greater omentum removed. (Gray.)

The *venous return* is provided for by a few esophageal veins that extend downward for a short distance over the cardiac portion of the stomach, and the gastric veins proper that drain into the splenic or superior mesenteric veins which are tributaries of the portal vein. This venous arrangement explains the occurrence of the esopha-

geal hemorrhoids, as well as the various gastric congestive states which are found, in the presence of long standing portal congestion.

The stomach, therefore, is a pouch formed in the digestive tube by a process of dilatation, in which the greater curvature represents the distended posterior wall of the tube which was dragged down-

Branches to greater omentum

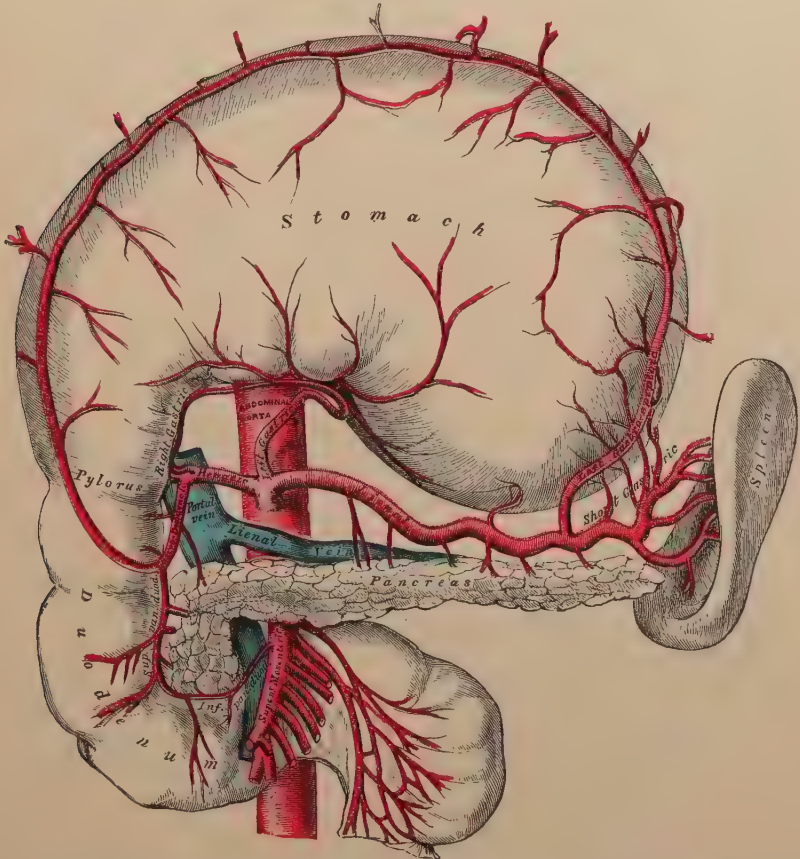


FIG. 25.—The celiac artery and its branches; the stomach has been raised and the peritoneum removed. (Gray.)

ward and rotated so that the left side of the tube, or primitive stomach, is now the anterior surface of the stomach, and contains the left pneumogastric nerve, while the right pneumogastric nerve supplies the posterior surface of the stomach. These are the *motor* and *secreto-motor* nerves of the stomach, and are sometimes referred

to as the parasympathetic or autonomic nerves of the stomach, and ultimately terminate in the plexuses of Auerbach and of Meissner respectively, within the muscular coats and the submucosa. The *sympathetic fibers* are derived from the celiac ganglion and plexus.

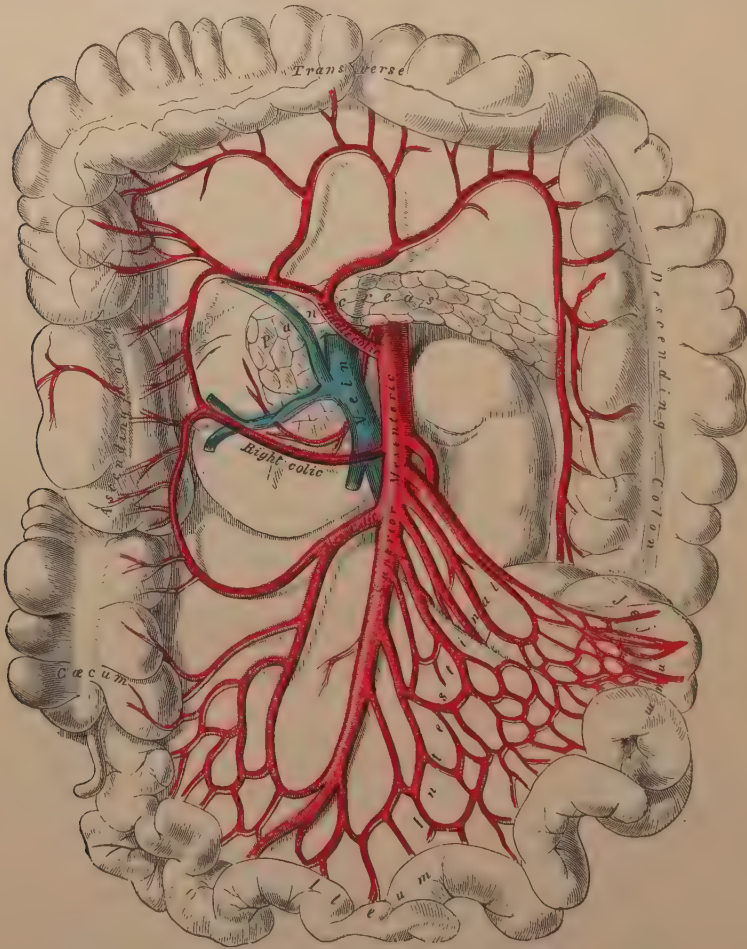


FIG. 26.—The superior mesenteric artery and its branches. (Gray.)

These, in turn, receive their impulses through the splanchnic nerves which run downward anterior to the vertebral column and behind the diaphragm to form the celiac, superior and inferior mesenteric and aortic plexuses.

The *lymphatics* are found in the loose areolar tissue of the sub-

mucosa and underlying the peritoneum, and drain toward the greater and lesser curvatures of the stomach.

Practical Considerations.—Interference to the passage of the tube to the duodenum may be provided by several pathological states of the stomach. Atony and dilatation may be so marked that

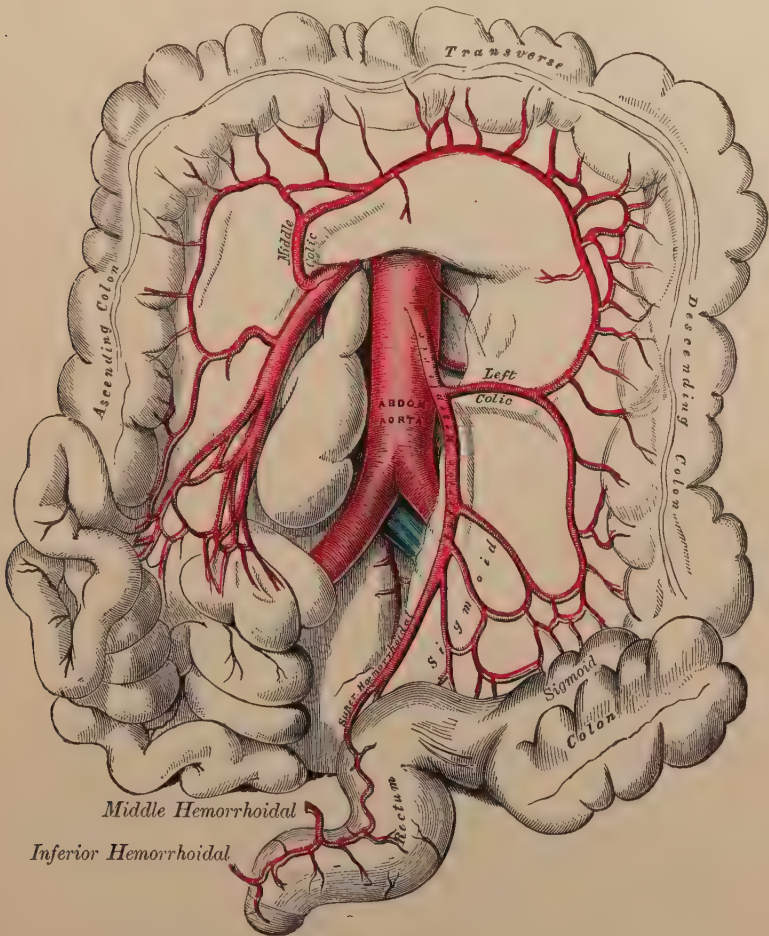


FIG. 27.—The inferior mesenteric artery and its branches. (Gray.)

normal tone and peristalsis is lacking to such an extent that the tip will not be grasped by the stomach walls sufficiently well to be propelled onward toward the pylorus. Even without pathology being present, extreme nervousness on the part of the patient may cause a transitory inhibition of peristalsis, or a condition that is

equally as bad from the operator's standpoint, that of pylorospasm. Either state may be produced in a patient who is worried by the tube; who is apprehensive; who is uncomfortable on the bed; or

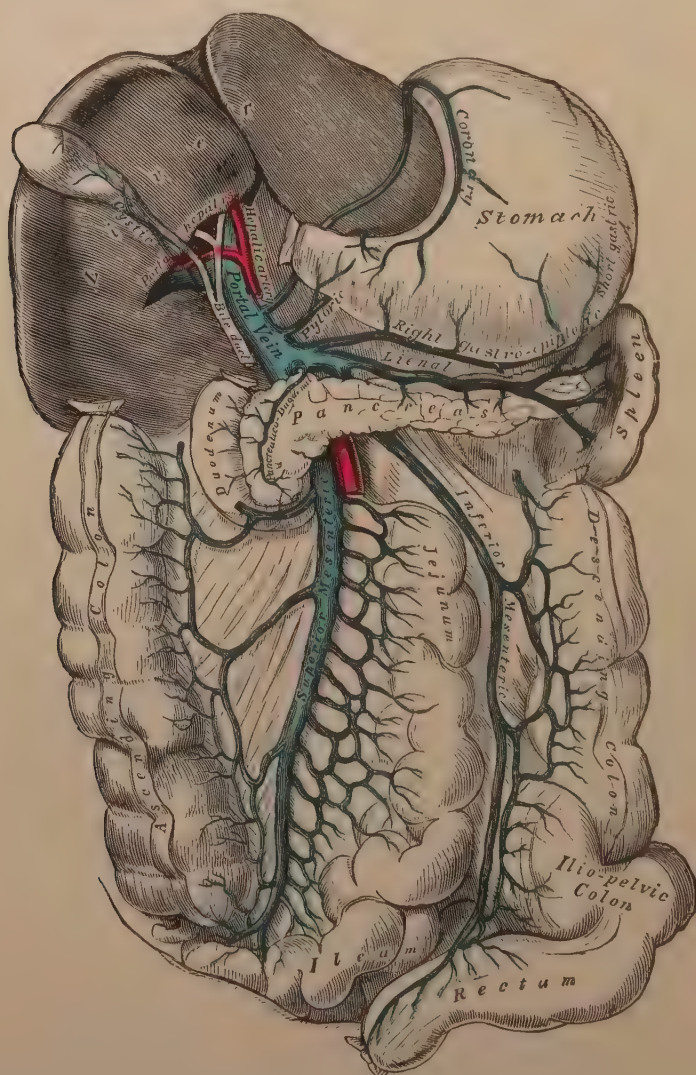


FIG. 28.—The portal vein and its tributaries. (Gray.)

who is limited in time because of a later business or social appointment, and knows that his drainage must be accomplished within a certain span of time. We must also mention in passing the hyper-

tonic or hyperperistaltic stomach that carries the tip of the tube onward so rapidly that it is not allowed to impinge properly on the

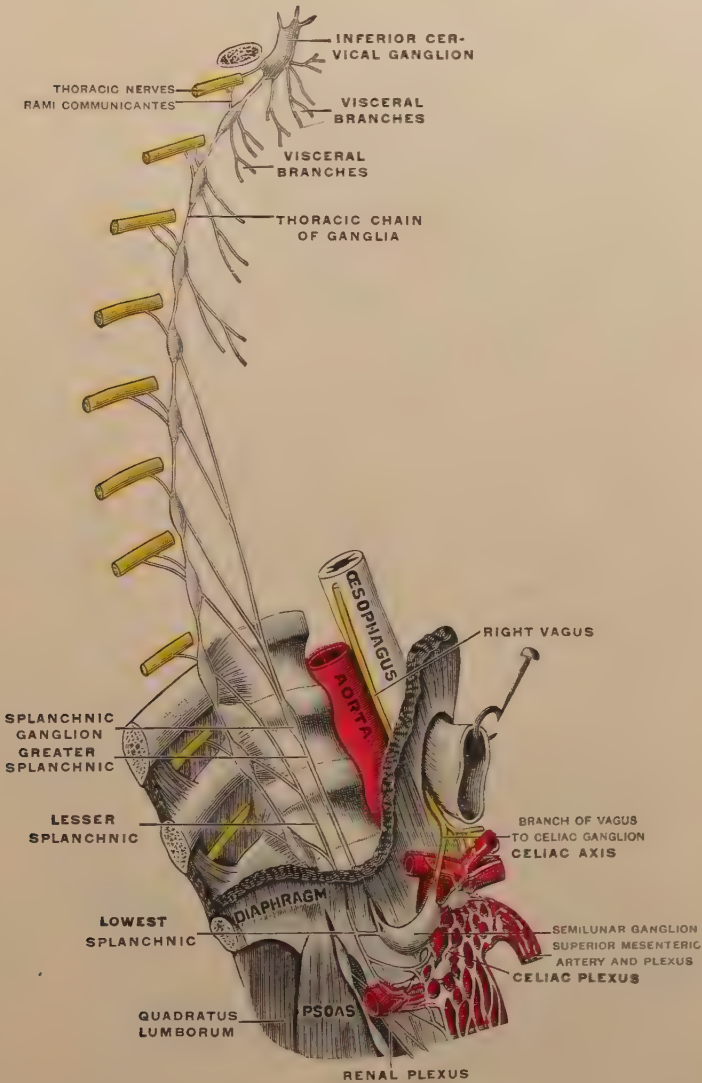


FIG. 29.—Plan of right sympathetic cord and splanchnic nerves. (Testut.)

pyloric opening, but is pushed to one side, causing it to turn backward within the stomach and form a loop or occasionally a knot in the tube. While ptosis may, in a few cases, give us some difficulty,

it is not a very likely source of trouble, as the stomach will usually rise to a more nearly normal position with the patient in the supine,

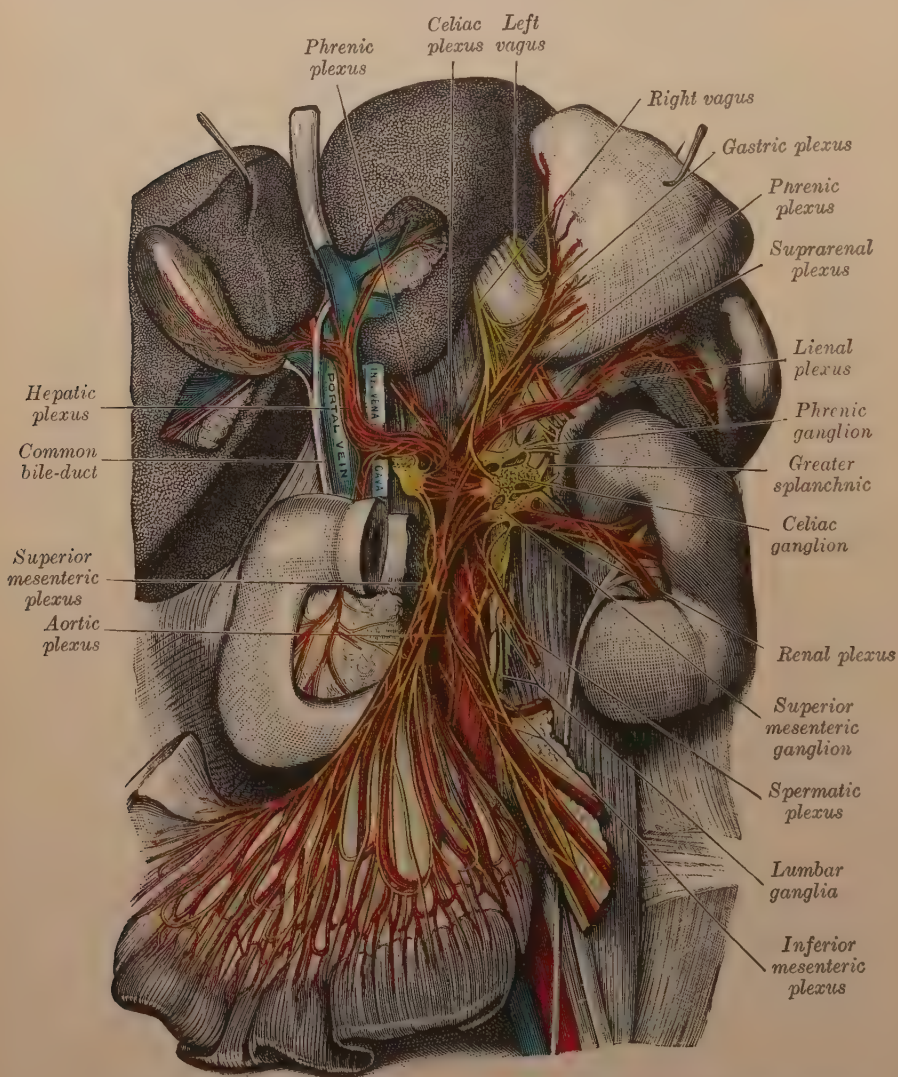


FIG. 30.—The celiac ganglia with the sympathetic plexuses of the abdominal viscera radiating from the ganglia. (Toldt.)

right lateral or prone position. The accompanying atony is most apt to be the cause of difficulty in tube passage in the occasional

ptotic case where various postures are tried and failure still follows. More rarely we encounter the hour-glass type of stomach, either the result of cicatricial contraction following the healing of ulcer, or the biloculation of the stomach accompanying ulcer and cancer,

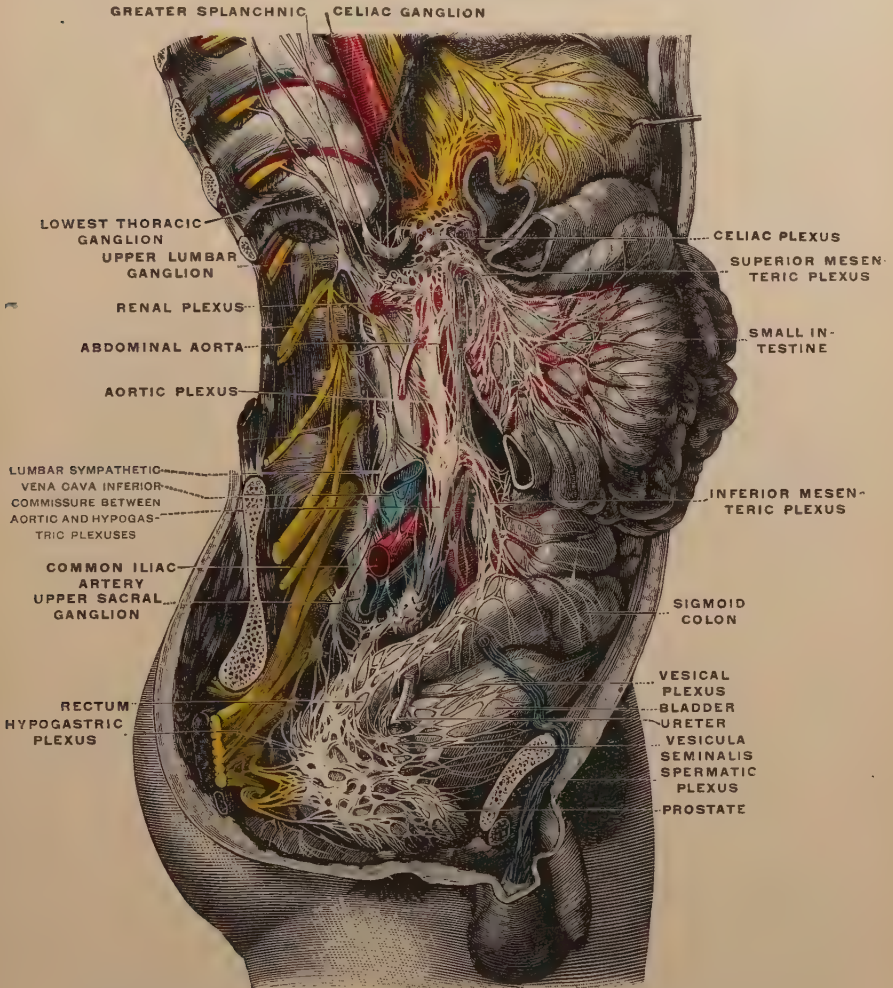


FIG. 31.—Lower half of right sympathetic cord. (Testut after Hirschfeld.)

in which an incisura appears in the wall opposite the lesion. There is also the state of functional biloculation that presents the fluoroscopic picture of hour-glass contraction, yet is without demonstrable lesion, in which the lumen will be contracted down to pencil point

size. Adhesions and extrinsic tumors may distort the gastric canal. Benign tumors, polypoid growths of the mucous membrane, may be near enough to the pylorus to provide obstruction to the exit of the tip from the stomach to the duodenum. Carcinoma (medullary) of the pyloric extremity of the stomach, when not of the scirrhus type, and ulcer in close relation to the pylorus may cause pylorospasm, and thus be responsible for failure to get our tube tip through the stomach and out into the abdomen. Lastly, any case on whom a gastroenterostomy has been performed will prove a most difficult one for successful intubation of the duodenum.

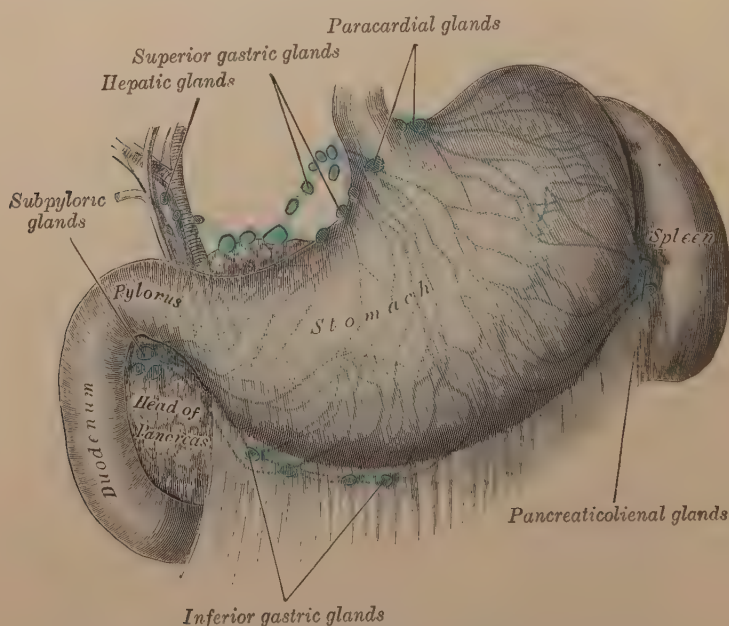


FIG. 32.—Lymphatics of stomach, etc. (Jamieson and Dobson.)

The Pylorus.—The pylorus is formed by an augmentation of the circular fibers of the stomach, together with plication of the mucous membrane of the stomach at the place of its juncture with the duodenum. Its function is to prohibit entrance of gastric contents into the duodenum until it be in the proper state of digestion for onward passage. Its action is regulated in normal persons by either the relative acidity of the gastric contents, the relative alkalinity or acidity of the duodenal contents, or the state of distensibility of the gastric or duodenal organs.

In the opened abdomen the pylorus is recognized by the increased

thickness of the wall by palpation, and by the presence of the encircling band of the pyloric veins. The lesser omentum (gastro-hepatic) as it passes down to the duodenum to form the hepato-duodenal ligament, provides for the passage of the *vessels and nerves* to this specialized ring of muscular tissue. It is supplied by branches from the vagus, irritation of which we believe will throw this con-

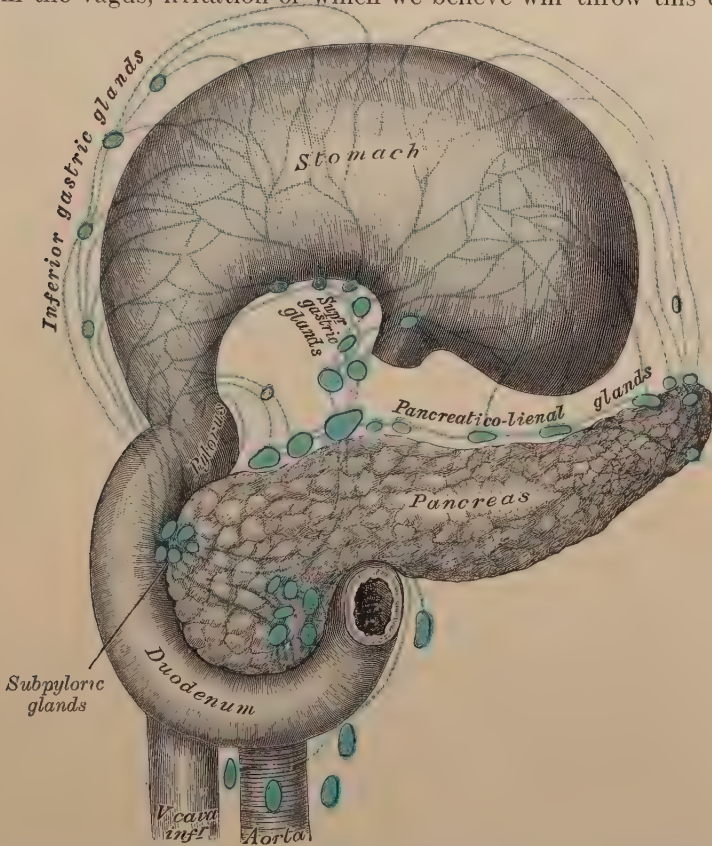


FIG. 33.—Lymphatics of stomach, etc. The stomach has been turned upward. (Jamieson and Dobson.)

stricting ring into a state of tonic contraction (pylorospasm as a symptom of vagotonia). Also, it is supplied by sympathetic fibers from the celiac plexus, stimulation of which cause relaxation of this sphincter. On the surface of the abdomen the normally placed pylorus underlies a point less than one inch to the right of the midline on the transpyloric line (drawn transversely midway between the jugular notch and the top of the symphysis) when the

subject is supine. When standing, however, we find by fluoroscope that the pylorus, contrary to former belief, is not a fixed portion

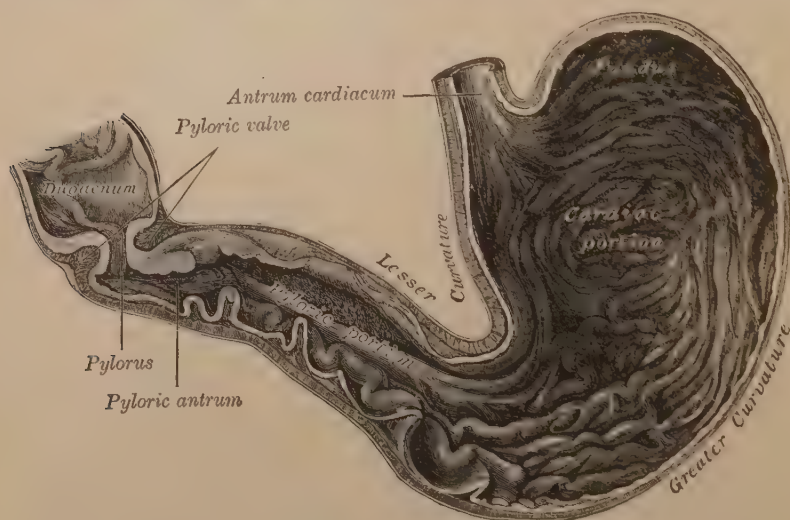


FIG. 34.—Interior of the stomach. (Gray.)

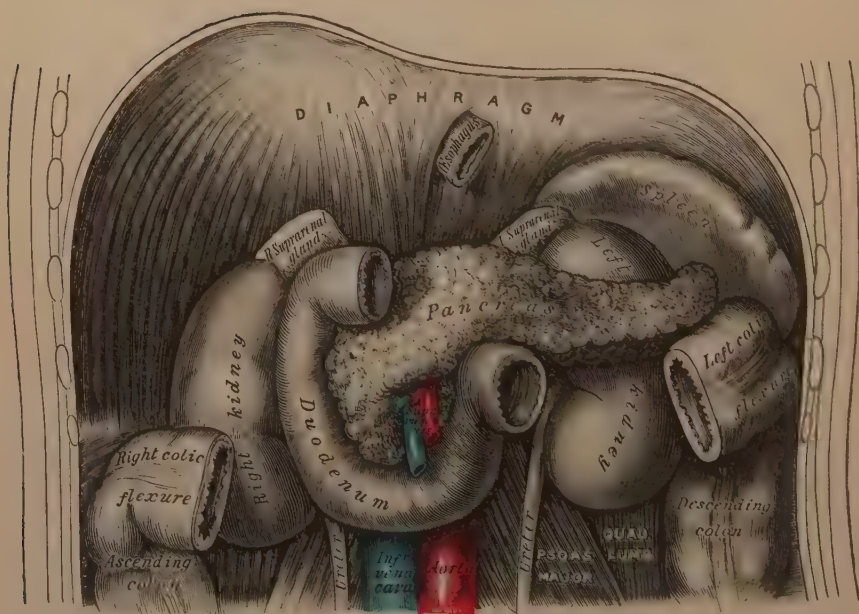


FIG. 35.—The duodenum and pancreas. (Gray.)

of the digestive tube, but is capable of considerable downward displacement in a ptotic individual, and that the first inch or two of the duodenum may descend along with it. From the cardiac orifice of the stomach there is no actual anatomically fixed point of attachment of the digestive canal to the body wall until we reach the descending or second portion of the duodenum. In the extreme ptotic type a sharp angulation may be produced well beyond the pylorus.

Practical Considerations.—Obstruction to the passage of the tube frequently occurs at the pylorus, either with or without demonstrable pathology. Reflex pylorospasm (tonic contraction) may

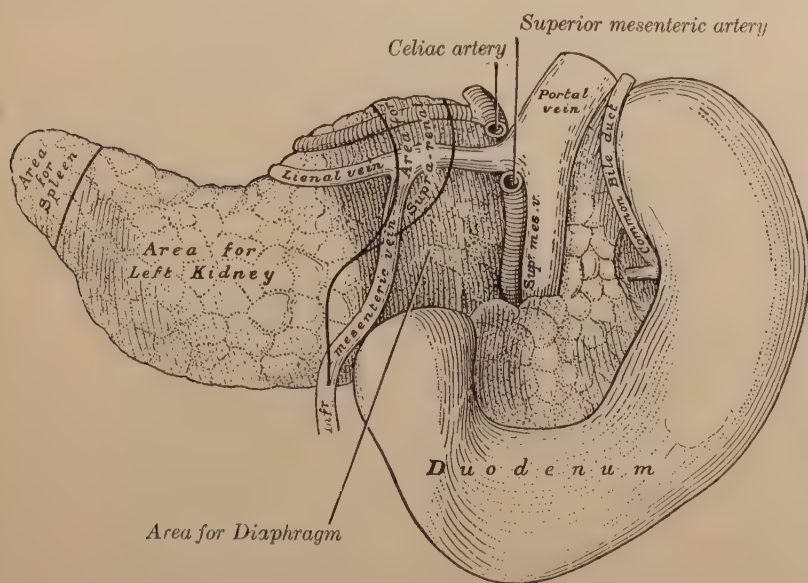


FIG. 36.—The pancreas and duodenum from behind. (From model by His.)

result from any mind or body discomfort, such as fear, excitement, hurry, dislike of the nurse, itching skin, pain, too hot or too cold a room, or lack of ease of posture. Tumors pressing on the pylorus, adhesions dragging the pylorus into abnormal positions, or ulcer near the pylorus acting as an irritant and causing spasm, may prevent the passage of the tip.

The Duodenum.—The duodenum is the first 10 inches of the small bowel beyond the stomach, and the pylorus marks the junction of the two. At its lower termination it becomes the jejunum. It is divided by some anatomists into *three segments*—an ascending or first portion, a descending or second portion, and a transverse

or third portion. Others name four portions, thus superior, descending, horizontal and ascending. The *first portion* is the only one whose position is subject to change by posture, as the proximal part (1 inch) is provided with a mesentery—the hepatoduodenal ligament, suspending it from the transverse fissure of the liver. This allows a fair amount of sag in the erect posture when the stomach is filled and is inclined to be ptotic. The second one inch of this organ is only partially invested with peritoneum, on its superior, anterior and inferior aspects and it becomes retroperitoneal in crossing the spinal column in a right, upward and backward direction on a level with the first lumbar vertebra. On its



FIG. 37.—The four types of anastomosis between ductus choledochus and duct of Wirsung, seen in cross-section of the duodenal wall. (From Letulla and Nattan-Larrier.)

anterior aspect it is in relation with the neck of the gall-bladder and the quadrate lobe of the liver, and behind it lie the common bile duct, the portal vein and the gastroduodenal artery recently given off from the hepatic artery as it courses upward in the free fold of the gastrocolic omentum to pass over the foramen of Winslow (the duodenum forming the lower boundary) to enter the transverse fissure of the liver. Beneath the first portion of the duodenum lies the head of the pancreas. The other portions of the duodenum encircle this part of the pancreas on the right and below. The *second portion* extends downward from the body of the first lumbar vertebra to the upper border of the fourth lumbar vertebra, in

close apposition to the right border of the spinal column and separated from it by the crura of the diaphragm and inferior vena cava. Behind, it is in relation with the right suprarenal body and right kidney and its vessels, and the psoas muscle. Above it lie the neck of the gall-bladder and the right lobe of the liver. To the right lies the hepatic flexure of the colon, which crosses the anterior face of the duodenum, and is attached to it by connective tissue. To the left lies the head of the pancreas and the common bile duct and the pancreatic ducts. These ducts empty their contents into the duodenum at a point about 4 inches (10 cm.) beyond the pylorus.

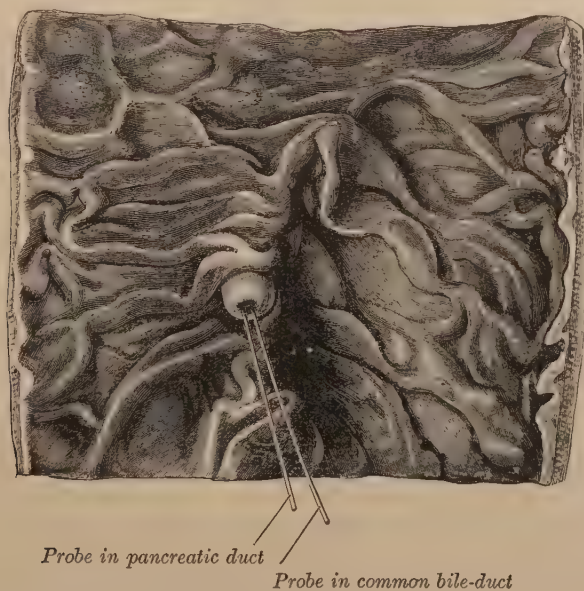


FIG. 38.—Interior of the descending portion of the duodenum, showing bile papilla. (Gray.)

They join the duodenum and pierce its wall diagonally, and discharge their contents into the lumen of the bowel through the *ampulla of Vater*. This is a small fusiform dilatation into which the bile and pancreatic ducts may open either as a duct common to both ducts (the common bile and pancreatic or *Wirsung's*) or as two separate ducts. The accessory duct of *Santorini*, when present, is usually found emptying less than an inch (2 cm.) above this point. The mucous membrane is thrown into a very slight series of folds about this orifice, forming the *papilla*, by a miniature sphincter (*Oddi's*) made up of muscular fibers arising from the duct walls, and closely associated and interlacing with the muscular

fibers of the duodenal wall. This papilla points downward into the bowel lumen and is very small (5 mm. or $\frac{1}{2}$ of an inch) and is often difficult to find in the rough mucosa; and the orifice of the ampulla is only 1 or 2 mm. ($\frac{1}{25}$ or $\frac{1}{12}$ of an inch) in diameter. We can therefore appreciate the severe traumatism that must result when even a very small stone passes this portion of the biliary apparatus.

The *remaining portion*, or portions, of the duodenum cross the crura of the diaphragm and the vena cava and the aorta, the left renal vessels and the left psoas muscle at the level of the third and second lumbar vertebræ in an upward and leftward direction by following the curve of these bodies with a convexity forward. From the last half of the first portion of the duodeno-jejunal junction the duodenum is retroperitoneal and firmly fixed, and lies in close contact within the pancreatic head, which may even partially envelop the bowel and appear to form part of the bowel wall by ingrowth of its tissue. The superior mesenteric artery and vein emerge under the body of the pancreas, and cross the duodenum in a downward direction. This is one point at which duodenal stasis may occur in the ptotic type of abdomen, as the weight of the bowel and mesentery may cause a serious compression where these vessels span the duodenum. Again, where the first portion joins the second, a very acute angle is formed and, should the stomach with the first portion of the duodenum be dropped downward, this angle is greatly exaggerated and an actual kink is possible. And, again, the same may be said of the duodeno-jejunal junction because here, too, the angularity is quite marked. The duodenum is fixed behind the peritoneum and as it emerges to become the jejunum (invested with a mesentery) it is further held more firmly immobile by a suspensory ligament (of Treitz) which extends from its superior surface to the tissue around the origin of the celiac axis.

The main *arterial supply* comes through the superior pancreatico-duodenal, a branch of the gastro-duodenal in turn coming from the celiac axis through the hepatic artery. The inferior pancreatico-duodenal springing from the superior mesenteric, supplies the lowest portion of the duodenum. The *venous return* is provided for by the pyloric vein and the superior pancreatico-duodenal draining into the portal vein; and by the inferior pancreatico-duodenal vein opening into the superior mesenteric which, in turn, opens into the portal vein. The *lymphatics* drain through the preaortic chain of lymph nodes. The *innervation* of the duodenum is through fibers from the celiac plexus of the sympathetic system of nerves. We have seen that the left vagus (tenth or pneumogastric) nerve, in forming the anterior plexus of the stomach, gives off its hepatic branches which pass up through the lesser omentum to the liver and gall-bladder. The right vagus nerve forms a similar plexus on the

posterior wall of the stomach along its lesser curvature. Fibers from this plexus pass to the celiac ganglia and thus by way of the sympathetic nerves the right vagus innervates the duodenum as well as the other abdominal organs. (11)

Practical Considerations.—Thus, with three possible points at which the peristaltic wave might meet with obstruction, it is not difficult to see how the normal physiology and the motility of this organ's contents might be interfered with; how stasis might be present; how bile pools may form and allow reflux into the stomach; and, finally, in the right lateral position, how the tip of the tube might be prevented from entering the second portion of the duodenum after traversing the stomach, pylorus and first portion of the duodenum, by the acute angulation of the gut at the point of juncture of the first and second portions. The simple expedient of turning the patient over on his abdomen for a few minutes (prone) or flat on his back (supine) will frequently remove the difficulty in this circumstance. Again, adhesions and extrinsic tumors may so distort the duodenum that the passage of the tip is impossible or rendered difficult.

The Liver.—The liver unless hardened *in situ* or engorged by blood, is a soft, brown pultaceous mass, which has very little form when removed from the dead body. In the living body it is fairly firm, and because of its relations to surrounding structures, it is moulded into a fairly definite form. But to study its true gross morphology it is necessary to view one which has been given solidity by the injection of hardening fluids while it lies in contact with the surrounding viscera.

The specific gravity of the liver is low, about 1.050. (8) Its weight varies from 1400 to 1750 gms. (3 to $3\frac{3}{4}$ pounds) and equals $\frac{1}{3.5}$ to $\frac{1}{4.0}$ of the total adult body weight. (6) In the new born it equals about $\frac{1}{2.0}$ of the fetal weight. It measures, transversely, 20 to 24 cm. (8 to $9\frac{1}{2}$ inches); vertically, through the right lobe, 16 cm. ($6\frac{1}{2}$ inches), and antero-posteriorly, 10 to 18.5 cm. (4 to $7\frac{1}{4}$ inches).

Most of its surface is covered over by peritoneum, through which the polygonal outline of the individual lobules (from 1 to 2 mm. in diameter) may be seen.

In viewing the *anterior surface* of a liver hardened *in situ* we see then the large right lobe, dome shaped above, and presenting a short inferior border, under which, near the body midline the fundus of the gall-bladder protrudes. Further along to the left is the umbilical notch, up from which, to the superior surface of the liver, extends the attachment of the falciform ligament. Beyond this line we find the left lobe shaped like a wedge, and of about one-sixth the size of the right lobe. Both of these lobes are in relation anteriorly with the anterior abdominal wall and the diaphragm.

On looking down on the *superior surface* of the liver we see only the large right lobe and the small left one, separated to the left of the mid-sagittal plane by the line of peritoneal reflection representing the attachment of the falciform ligament. This reflected peritoneum sweeps off to either side to form the right and left coronary ligaments, the extreme outer ends of which are the triangular or lateral ligaments. Behind this line of peritoneal reflection on the right lobe, we see the cut upper end of the inferior vena cava. This superior surface is only in relation to the diaphragm, but we find a depression on the left lobe made by the heart as it lies above it on the diaphragm.

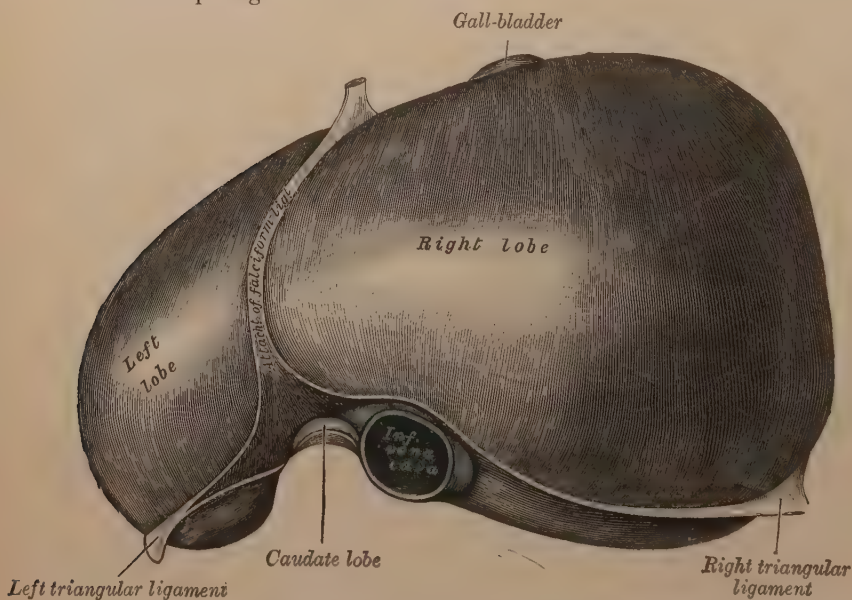


FIG. 39.—The superior surface of the liver looking down on it from behind. (From model by His.)

The *posterior surface* of the right lobe is mostly non-peritoneal, and is closely attached to the diaphragm by connective tissue and, to a lesser extent, by the falciform coronary and triangular ligaments, which are in fact, thin peritoneal reflection from the liver to the diaphragm. Within this non-peritoneal area, and close to the spinal column, we see a depression caused by the right suprarenal body and, to its left, and imbedded in the liver substance, we see the terminal portion of the inferior vena cava. Further to the left, where the liver swings across the crura of the diaphragm covering the anterior surface of the spinal column, we find the long, upright caudate (Spigelian) lobe, really a part of the right lobe. At its

inferior pole we find the caudate process of this lobe lying between the vena cava and the transverse fissure. The left lobe has no posterior surface, but only a posterior border which close to the left side of the spinal column, is indented by the esophagus as it enters the stomach. The fissure for the ductus venosus separates the left lobe from the caudate lobe. The right lobe, posteriorly, below and beneath, is marked by a depression caused by the right kidney. This area is covered by peritoneum, while the right suprarenal capsule is in actual contact with the liver substance; so we will note that the coronary ligament spreads away from the posterior surface of the liver to the anterior surface of the right kidney at its upper pole.

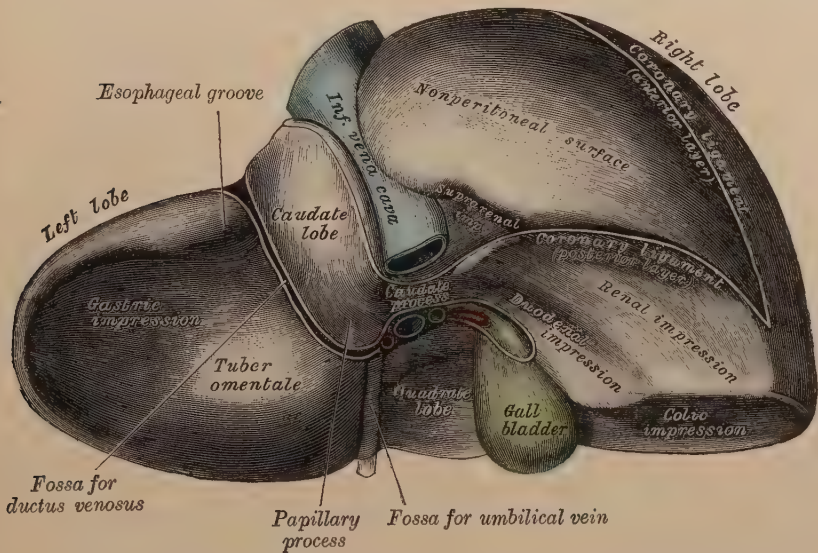


FIG. 40.—Posterior and inferior surfaces of the liver. (From model by His.)

Viewing the *inferior surface* of the liver we see that the left lobe spreads over the stomach, very much as the left lung covers the heart, so that the relation of this lobe to the stomach is considered to be superior as well as anterior to the stomach. Separating the under surface of the right lobe from the left lobe, we see the depression containing the round ligament. The quadrate lobe lies between this fossa and the gall-bladder depression. Behind the quadrate lobe we find a *transverse fissure* known as the *portal fissure* and it is from 4 to 5 cm. ($1\frac{1}{2}$ to 2 inches) long. (8) Here enters the portal vein with the hepatic artery to its left, and to its right lies the hepatic duct carrying the bile from the liver to the cystic duct and the common bile duct below. Accompanying the portal vein there

are sympathetic and left pneumogastric (vagus, tenth) nerve fibers and lymphatics all united in Glisson's capsule. This capsule made up of areolar (loose connective) tissue accompanies the vessels in all of their numerous ramifications throughout the liver substance, outlining the various lobules all the way to the periphery of the liver. The peritoneum which covers the liver is here reflected back over the vessels to form the gastrohepatic or lesser omentum, which was spoken of before as carrying the hepatic artery on its way from the celiac axis. At the left end of the transverse fissure the peritoneum is reflected as the falciform ligament anteriorly. It

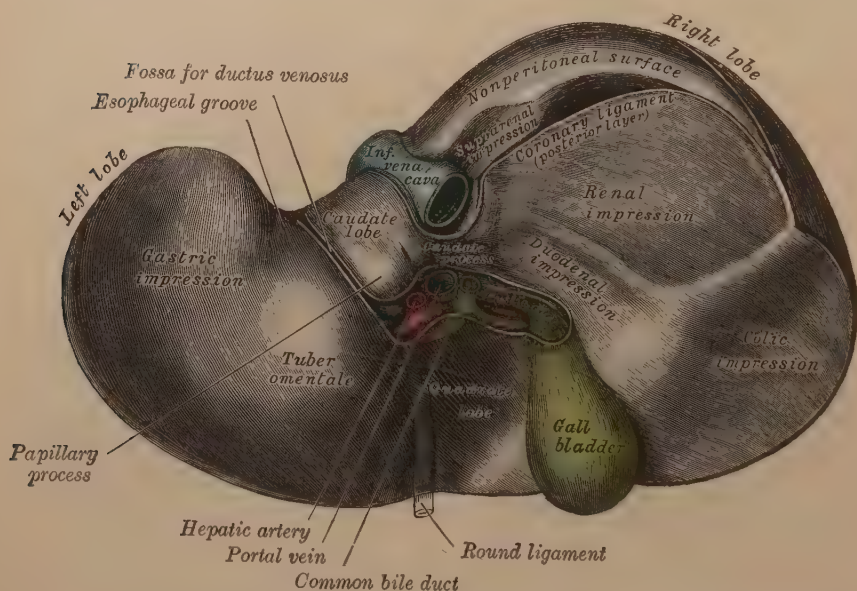


FIG. 41.—Inferior surface of the liver seen from behind and below. (From model by His.)

is attached to the liver at the fossa containing the round ligament, and sweeps around and up over the anterior surface of the liver at the umbilical notch to make its attachment to the diaphragm. Posteriorly from the left end of the portal fissure continues the lesser omentum along the line of the ductus venosus. To the right the peritoneum sweeps forward to enclose the cystic duct, and then out under the gall-bladder, covering only its under surface, the upper surface of which is closely imbedded in the liver substance. To the right of the gall-bladder the liver is in close contact with the first portion of the duodenum; still further to the right with the right kidney, and anteriorly the under surface caps the hepatic

flexure of the ascending colon, just as the left lobe overspreads the stomach. Posteriorly to the transverse fissure the caudate process overhangs the foramen of Winslow or the epiploic foramen.

In the fetus *the circulation* was directed through the umbilical veins, now the round ligament to the portal vein. Part of the blood entered the liver by this route, while the rest of the blood was carried by way of the ductus venosus up behind the liver to the inferior vena cava. That which entered the liver traversed the ramifications of the portal system of veins to eventually emerge through the two large and several small hepatic veins which enter the vena cava as it lies imbedded in the posterior surface of the liver. At birth both the umbilical veins and ductus venosus became closed off, later to atrophy. Thus all of the blood now in the portal system filters through the liver to make its exit to the vena cava by way of the hepatic veins, which join the vena cava on the posterior surface of the liver.

The **portal vein**, the functional vessel of the liver, is more than 15 mm. ($\frac{1}{2}$ to $\frac{3}{4}$ inch) in diameter, and is made up as we have seen, from the splenic, gastric, inferior and superior mesenteric veins. It carries all the blood flowing back to the heart from the stomach, from the spleen, from the pancreas, from all of the small and from most of the large intestines. It enters the transverse fissure, as we have noted above, accompanied by the nerves and lymphatics as well as the hepatic artery (the nutrient vessel of the liver) and the gall-duct. These vessels divide into right and left main trunks, which in turn ultimately become split up into fine microscopical vessels surrounding each lobule and penetrating its substance. In cirrhosis, with the deposition of connective tissue, the flow of blood is here obstructed and is dammed back within the portal vein so that the accessory portal systems become engorged. As a result the esophageal veins may become distended, producing the so-called esophageal piles, through a stagnation of blood in the gastric veins attempting to take a backward course through the esophageal veins on its way to the azygos veins within the chest. Or through the veins in the falciform ligament to the periumbilical veins in the skin surrounding the umbilicus the back flow of blood may produce the caput medusæ. Or, again, by way of the inferior mesenteric to the rectal veins, this damming of the hepatic portion of the portal blood may produce internal as well as external hemorrhoids. All these veins are valveless, otherwise this back flow could not so readily be brought about. Other veins, such as those draining up through the diaphragm, may too become engorged, and appear like little spider-web venules running transversely across the anterior thorax just above the costal margin.

The liver is made up of two *types of tissue*. A mesoblastic stroma

derived from the septum transversum, the capsule of Glisson, which supports the blood and lymph vessels, the bile or gall-duets and the nerves; and enclosing each separate lobule. The lobules are made up of secreting modified tubular glandular cells derived from the endodermic layer lining the duodenum. The whole liver except in such places as described above is covered with peritoneum, called the tunica serosa. Beneath this we find a fibrous sheet covering the whole organ, continuous at the portal fissure with the capsule of Glisson.

The portal vein and the hepatic artery, after repeatedly dividing, are eventually reduced to capillary size—the interlobular branches forming the *interlobular plexuses*. From these blood spaces which

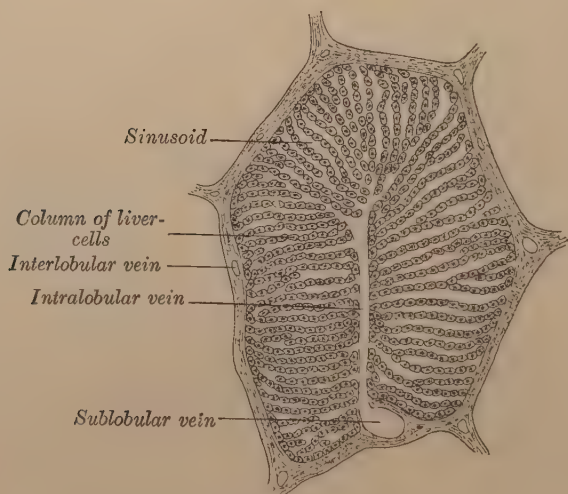


FIG. 42.—A single lobule of the liver of a pig. $\times 60$. (Gray.)

surround the lobules the blood enters the periphery of the lobule by way of the sinusoids—small blood channels, whose walls are incomplete, and are lined with irregular stellate endothelial cells (cells of Kupffer). These channels lying in the intralobular reticulum, an extension of Glisson's capsule, so convey the blood within the lobule that it comes into intimate contact with the individual *hepatic cells*, which are in turn channeled to admit the blood corpuscles within their own protoplasm. These cells are polyhedral in outline, with a diameter of from 12 to 21 microns (.015 to .025 mm.) and contains one or two nuclei as well as inclusion granules of iron compounds, glycogen, oil droplets in the cells near the periphery and bile pigment in those near the center of the lobule. The intralobular blood sinusoids converge toward the center of the lobule to

form the intralobular vein. This unites with others as they emerge from surrounding lobules to form the sublobular veins, which in turn form the hepatic veins three or more in number as they traverse the substance of the liver to empty into the inferior vena cava, where it is seen imbedded in the substance of the liver behind the right lobe. You will note then that the functional blood from the portal vein, and the nutrient blood from the hepatic artery, take much the same course in entering the lobule from the outside, and filtering through it to the draining vein within the center of the lobule.

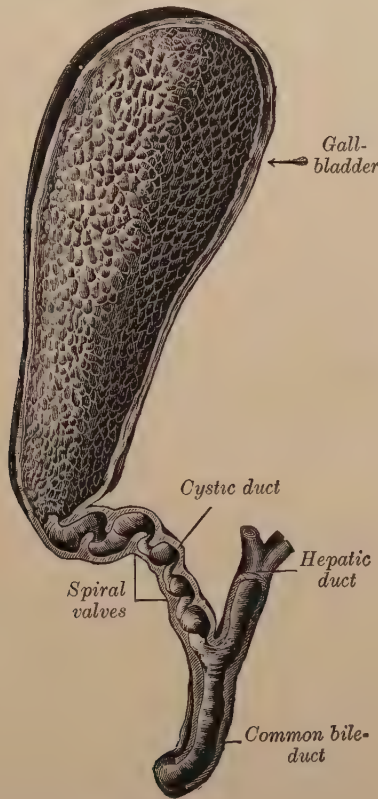


FIG. 43.—The gall-bladder and bile ducts laid open. (Spalteholz.)

In much the same way as the blood was brought into intimate contact with the individual liver cells by flowing through the sinusoids, we find the *bile delivered from the cells*. Small channels within the cells unite to form intercellular biliary canaliculi which unite to form the intralobular ducts lined with low cuboidal epithelium and pass outward to the surface of the lobule in a radiating manner

to form the interlobular bile ducts lined with cylindrical epithelium, which in turn unite and eventually form the lobular biliary duct. The walls of the larger biliary ducts are made up of connective tissue, in which is imbedded both longitudinal and circular muscular fibers, and the whole is lined with low columnar (cylindrical) epithelial cells.

The two large *biliary ducts*, one from the left lobe and a larger one from the right lobe of the liver, unite just beyond the transverse fissure to form the *hepatic duct*. This duct is 20 to 40 mm. ($\frac{3}{4}$ to $1\frac{1}{2}$ inches) long, with a diameter of 4 to 6 mm. and descends ($\frac{1}{4}$ inch) on the right of and anterior to the portal vein in the gastro-hepatic (lesser) omentum lying on the top of the first part of the duodenum. Here it joins the cystic duct coming from the gall-bladder to form the common bile duct. It is lined with mucous membrane covered over with simple columnar epithelium with numerous stomata in its surface marking the openings of many small tubular glands. Its walls are made up of fibro-elastic tissue scantily supplied with unstripped muscular fibers.

The Cystic Duct.—The cystic duct has a diameter of 2 or 3 mm. (less than $\frac{1}{4}$ inch); its length is 3 to 4 cm. (less than 2 inches), and it opens in the side of the hepatic duct within the gastro-hepatic omentum. Its walls have more of the muscular element than the hepatic duct. The mucous membrane is covered with simple columnar epithelium, and is thrown into transverse folds or plications, which somewhat resemble valves (Heister). This duct anteriorly, by bending sharply on itself, opens into the gall-bladder.

The Gall-bladder.—The gall-bladder is a pear-shaped or modified cylindrical vessel, 8 to 10 cm. ($3\frac{1}{4}$ to 4 inches) long, with a cubical content of from 30 to 60 cc (1 to 2 ounces) or more. The gall-bladder is closely attached by connective tissue to the under surface of the liver substance throughout its length, and its vessels and lymphatics freely anastomose with those of the liver in this region. Its under surface is covered by peritoneum which sweeps on to it from the adjacent liver surfaces. It is in relation above with the under surface of the right lobe of the liver, lying in the gall-bladder fossa to the right of the quadrate lobe. Its fundus, the portion nearest to the surface of the abdomen, peeps out below the inferior border of the right lobe near the forward end of the ninth right rib—the right ninth costal cartilage. Below, it rests on the transverse colon, and behind, where it opens into the cystic duct, it lies on the right and superior surfaces of the first part of the duodenum. Its blood supply comes through the cystic artery, a branch of the hepatic, and by branches from the hepatic arterioles within the liver substance overlying it. Its venous return opens into the right branch of the portal vein. It receives motor fibers from the left pneumogastric

(vagus, tenth) nerve; and through the non-medullated fibers of the sympathetic nerves, arising in the solar plexus around the celiac axis it received motor and inhibitory impulses. The right phrenic nerve, derived from the fourth cervical, sends branches with the hepatic nerve. Pain, therefore, may be referred to the right shoulder through the supra-acromial nerve, also a branch of the fourth cervical. (2)

The minute anatomy of the gall-bladder, that dealing with its structural components, is not brought out well in most text-books. The author is indebted to Sudler (12) and later writers, Harer, Hargis and Van Meter (4) for much of the following description of the histological and finer anatomy of the gall-bladder.

Study of the mural structure of the normal human gall-bladder is made difficult for the reason that this organ can rarely be obtained early enough after death. Within a few hours the mucosa is gone, and bile staining the deeper structures prevents a satisfactory histological study.

The wall of the gall-bladder varies in thickness, depending upon its state of distention. When distended it may be only $\frac{3}{4}$ mm. thick, whereas in a state of contraction it may measure as much as 2 mm. This thickness represents all four coats, *a*, the mucous (mucosa and tunica propria); *b*, the fibromuscular; *c*, the subserous or fibrous; and *d*, the serous or peritoneal coats.

The *mucosa* is composed of a layer of simple tall columnar epithelium mounted on a frail muscularis mucosa, together with some tubular gland. The whole coat is thrown into a series of folds, or ridges, when the wall is contracted, resembling somewhat the rugæ of the duodenum, but much smaller. The fold itself is formed by a ridge on the surface of the second or fibro-muscular coat, composed of connective tissue, supporting a network of capillaries. At the bases of these folds are found the solitary lymph follicles and a network of lymph channels, becoming confluent as the neck of the gall-bladder is reached, and anastomosing with those of the deeper or subserous layer.

The second, or *fibro-muscular coat*, is the thickest and most dense of all the layers of the gall-bladder wall, yet very much thinner than the muscular element of the urinary bladder (Mayo). The muscular element is of the unstriped, smooth or involuntary variety, the fibers interlacing in many directions, but tending to take on in general a circular, or transverse arrangement. In this layer the lymph channels are scarce, but the nerves and larger bloodvessels are found here.

The third or *subserous layer* is made up of elastic tissue, and is very rich in lymph channels, and comparatively poor in smaller bloodvessels and capillaries. Where the gall-bladder is applied to

the liver substance there is a free communication of the lymph and vascular systems with those of the liver. In general the lymph channels of the gall-bladder tend to run together as the cystic duct is reached, and to travel along with it, draining into lymph glands

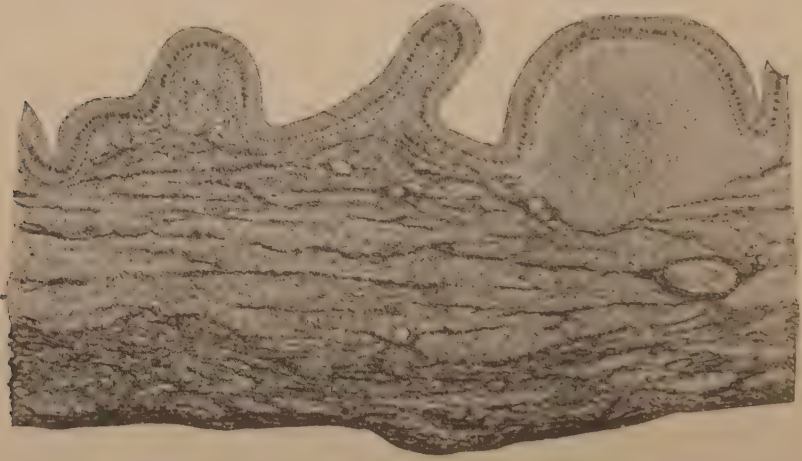


FIG. 44.—Section through the contracted gall-bladder of a dog, magnified eighty times, showing the arrangement into coats and the relations of the bloodvessels. (Sudler.)

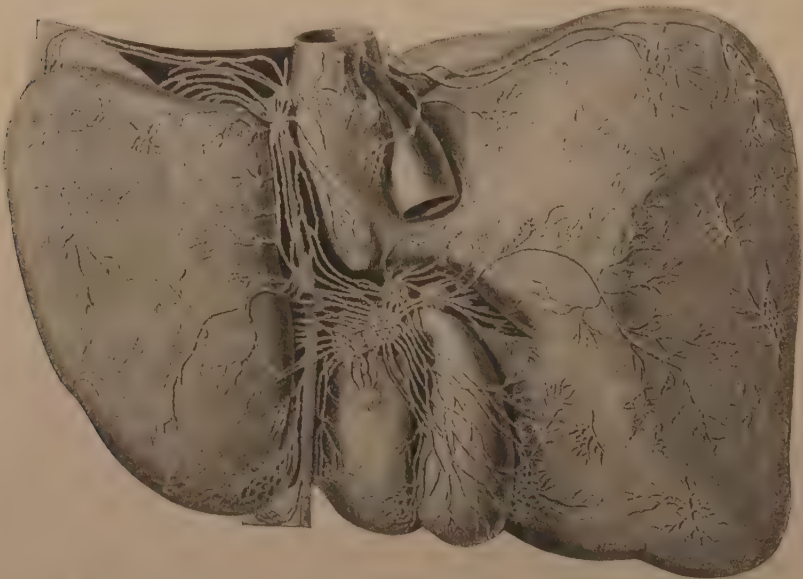


FIG. 45.—Lymphatics of the liver and gall-bladder, posterior view. (Modified from Sappey.)

around the head of the pancreas, in common with the lymphatics draining the under surface of the liver.



FIG. 46.—Gall-bladder of a man, aged nineteen years, dead of chronic nephritis, showing large superficial lymphatics. This gall-bladder gave evidence of having been through an inflammatory process, and so the lymphatics are probably abnormally numerous. (Sudler.)



FIG. 47.—The relation of the lymphatics of the gall-bladder to the head of the pancreas. (Francke.)

The fourth or *peritoneal layer* is very thin and as described elsewhere does not completely invest the gall-bladder, being absent from its upper surface.

The anomalies and abnormalities of the gall-bladder are few. In the lower animal kingdom, the horse, pocket-gopher, rhinoceros, rat and deer (these are all herbivora) possess no gall-bladder. But there are only about 30 cases on record of absence of the human gall-bladder. Some of these cases may have resulted from a congenital obliterative process beginning in the bile ducts. The true cases of absence of the gall-bladder usually show a compensatory dilatation

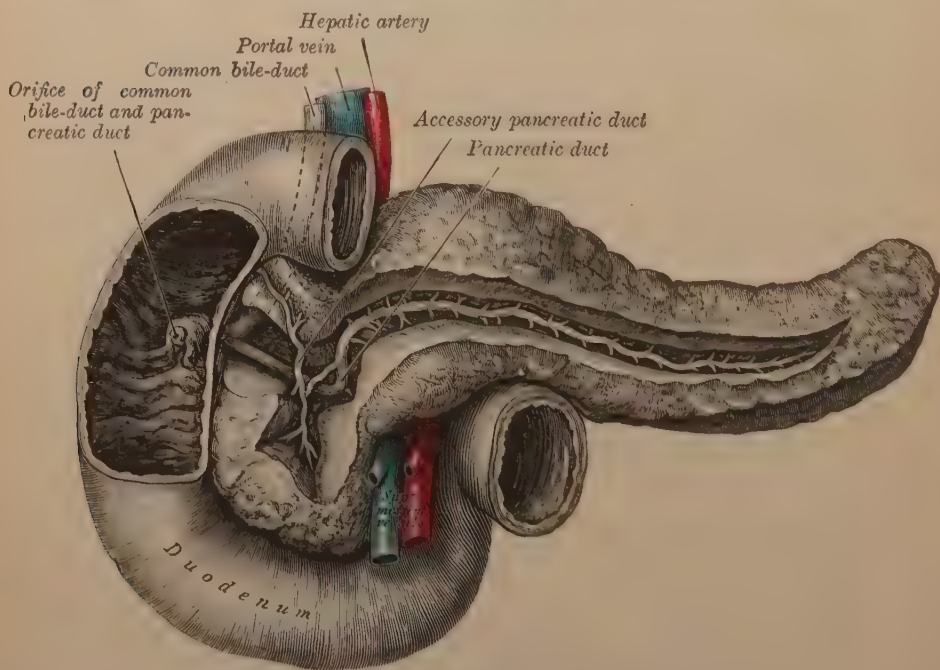


FIG. 48.—The pancreatic duct. (Gray.)

of the bile ducts similar to that following cholecystectomy (9). There may be two gall-bladders, each having a cystic duct; or a single gall-bladder may be divided by a septum, producing the bifid type. It may rarely be imbedded within the liver substance; or, again, the whole bladder may be swung from its bed by a mesentery (9). It may be constricted, thus presenting the appearance of the hour-glass type. Peritoneal bands or veils may extend from its fundus to the omentum or to the hepatic flexure of the colon. In 13 cases the gall-bladder has been found to the left of the longitudinal fissure. (10)

The Common Bile Duct.—The common bile duct is the continuation of the hepatic duct from the point where it is joined by the cystic duct within the gastro-hepatic omentum, 1 inch below the transverse fissure of the liver. It is 7 cm. ($2\frac{3}{4}$ inches) long, and has a diameter of from 6 to 7 mm. ($\frac{1}{4}$ inch) above, gradually lessening as it nears the point of penetration of the duodenal wall. Its walls are fibro-muscular, but thinner than the cystic duct, and it is lined with a smooth mucous membrane covered over with simple columnar epithelium. With the hepatic artery to the left of it, and the portal vein behind it, it descends from the transverse fissure in the fold of lesser omentum (gastro-hepatic) forming the anterior boundary of the foramen of Winslow (the caudate process of the spigelian lobe forms the upper boundary; the first portion of the duodenum forms the lower boundary). Thus its course is not unduly long before it becomes applied to the left posterior wall of the duodenum at the point where the duodenum makes its first sharp turn downward, and after descending along the left wall of the second portion of the duodenum, where it is joined by the pancreatic (Wirsung's) duct. Almost within the substance of the head of the pancreas it pierces the wall of the gut at an acute angle. After coursing for about one-half inch within this muscular tube, it opens either into the lumen of the duodenum through a separate stoma, or through a common stoma with the pancreatic duct by way of the ampulla of Vater, in the papilla which is described under duodenum (page 51.)

The Pancreas.—The pancreas is a serous racemose gland in which the saccular arrangement of the secreting gland cells closely approaches that of the compound tubular type. The cells are mounted on a basement membrane at one extremity, and open on the other within the lumen of the tubule. They are characterized, depending upon their state of functional activity by an inner zone (toward the lumen) of a markedly granular cytoplasm, and an outer clear zone which contains the nucleus. After prolonged activity of the organ, the granules (zymogen) are wanting and the whole cell cytoplasm is more likely to be found clear. The tubules converge and form interlobular ducts in the connective tissue stoma which by confluence eventually form the pancreatic ducts. These ducts are lined with a single layer of simple columnar epithelium, which increases in height as the ducts course away from the tubular alveoli of the gland. Between the alveoli throughout the pancreas, but much more numerous in the tail than in the body or head, are found collections of small, non-granular, polygonal cells grouped about the interlobular bloodvessels. These are the islands of Langerhans, and because of their anatomical relations to the bloodvessels, and because of the absence of drainage ducts from these

areas, they are thought to be concerned in the elaboration of an internal secretion.

You are referred to the section on embryology for a description of the development of this gland. (Page 21.)

The weight of the pancreas ranges from 30 to 150 gm. (1 to 5 ounces). Its length is about 15 cm. (6 inches). It has been roughly described by anatomists as having (from right to left) a head, neck, body and tail. The body is from 4 to 5 cm. (2 inches) broad on its anterior surface.

The pancreas, as we have previously pointed out, lies posteriorly, on the bodies of the first and second lumbar vertebræ as they are covered by the crura of the diaphragm; the inferior vena cava on the right of the spine; the portal vein in front of the spine; and the

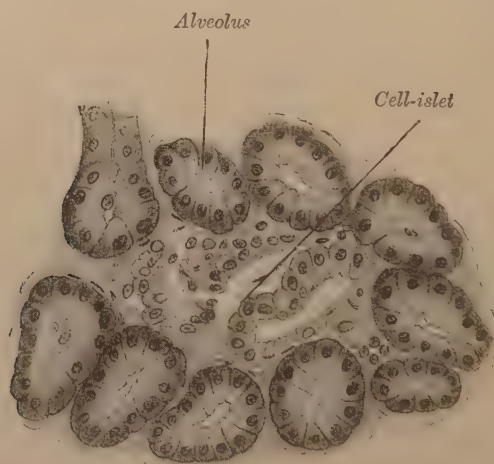


FIG. 49.—Section of pancreas of dog. $\times 250$. (Gray.)

aorta (giving off the celiac axis above the pancreas and the superior mesenteric artery below the gland) slightly to the left, and still farther to the left the left kidney and the spleen. Transversely across its back run the splenic artery above and the splenic vein below. Above it and anteriorly, are the stomach and the transverse colon, while the duodenum winds around its right extremity (the head). Below it is in relation with the transverse mesocolon; the superior mesenteric artery emerges from beneath it, to cross the duodenum, to the right of where this gland comes in contact with the duodeno-jejunal junction.

It is entirely retroperitoneal except the tip of the tail (the splenic end). The peritoneal layer covering its face belongs to that of the lesser peritoneal cavity, and as it sweeps down over the anterior surface of the gland it is seen to be continuous with the superior

layer of the transverse mesocolon which eventually spreads upward over the posterior surface of the stomach. Its blood supply comes from the splenic artery as it runs across the back of the gland; from the hepatic artery as it courses along the upper border of the head on its way from the celiac axis to the gastro-hepatic omentum; and from the superior mesenteric artery which sends two recurrent branches after emerging from under the lower border of this gland. Its veins empty into the portal vein. The lymphatics mainly run backward to the celiac lymph nodes. Those of the tail run toward the spleen, and those of the head roughly follow the pancreatic duct.

The nerve supply is from the celiac, splenic and superior mesenteric plexuses of the sympathetic system. It received secreto-motor fibers from the right vagus, which form plexuses within its substance (3).

The *pancreatic ducts* are two in number. The important one in 75 per cent of cases is the duct of Wirsung. It begins near the tail, the left end of the pancreas, and traverses the central part of the pancreatic mass, receiving branches all along the course as it travels from left to right to emerge at the head, where it joins the common bile duct with which it enters the wall of the duodenum to discharge its contents by way of the ampulla of Vater either through an individual stoma or through a stoma common to the two ducts. Its greatest diameter is about 5 mm. (less than $\frac{1}{4}$ inch). The lesser duct, that of Santorini, may communicate with that of Wirsung within the head of the gland. It extends in most cases, as an insignificant tube from the head, and enters the duodenum more anteriorly, and discharges its contents about one-half inch above the papilla. (See pages 50 and 51.)

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CHAPTER II.

THE PHYSIOLOGY AND PATHOLOGICAL PHYSIOLOGY OF THE LIVER AND BILIARY SYSTEM.

IN the foregoing chapter the development and final architectural structure of the liver and its excretory passages have been considered. We must now turn to a consideration of the functions that this large glandular organ and its efferent duct system performs, both when working harmoniously with the rest of the organism and when through the presence of disease, localized or distant, there is a failure of the normal harmony.

The liver is the largest and the most important glandular structure in the body. Neither man nor any of the higher animals can live for more than a few hours without it. Pouring, as it does, its secretion into the first part of the small intestine, it was evident even to the earliest students of anatomy that it was connected with the process of digestion. Yet it has only been within a comparatively short time that a truer appreciation has been reached of the important part the liver plays in regard to metabolism and digestion. Situated as it is between the portal and systemic circulation, it acts as a filter for such poisons as may be absorbed from the gastrointestinal tract, destroying them or neutralizing them as they pass through its rich capillary network. It also serves as a laboratory where the final split products of protein and carbohydrate digestion that are carried to it in the portal blood can be converted into compounds more readily stored against future need or made more suitable for use by the individual cells in their internal metabolism.

It is not within the compass of this book for us to go into a detailed or technical discussion of the various ramifications of the physiology of the liver and its connection with the fundamental metabolic processes of the body. We are concerned more especially with only one phase of liver activity, its external secretion, the bile. Yet we must not lose sight of the fact that, judging alone from its size, its extensive blood supply and its important position between the portal and systemic venous systems, that the secretion of bile (800 to 1500 cc in twenty-four hours) is not its most important function.

In investigating the formation of bile the first thing of importance to remember is that it is a continuous process, although subject to fluctuations in the velocity of its secretion. In this respect it differs

fundamentally from the other glands that empty their secretions into the gastro-intestinal tract, and approaches the functional mechanism of the kidney. Unlike the kidneys, however, which simply extract and excrete certain substances which are presented to them in the blood, the hepatic cells themselves manufacture the specific components of the bile, and therefore it is to be considered as an excretion as well as a secretion. There is certain evidence (18) which will be discussed in the next chapter, that some of the substances in the bile may be formed in small amounts by cells outside the liver. One proof that the secretion of bile is not a simple filtration process is the fact that the secretory pressure (10, 14) of the bile is greater than the pressure in the portal vein. (2) There are no enzymes in the bile, although Leeds (12) believes the gall-bladder adds a hormone which increases bile formation. There is also no direct nervous control of the formation of the bile, for there is a continuation of bile secretion even after all the nerves to the liver have been sectioned.

The secretion is influenced by various things. It is increased by an increase of hydrostatic pressure. It is more strongly influenced by the ingestion of food. This increase, however, is not caused by the presence of food, but only follows its partial digestion and absorption and the carrying of these secondary substances to the liver. Certain types of foods have a greater influence on the secretion of bile than others. The most marked increase is seen to follow the ingestion of protein and the absorption of the products of its partial digestion, the proteoses, peptones and albumoses. This increase commences about one-half hour after the ingestion of the food and reaches its maximum in about four hours. Fats produce the next most marked increase, beginning in about one hour and reaching a maximum in about five hours. Carbohydrate is followed by but a small increase in the formation of bile, but its influence is felt over a longer time.

So much for the secretion of bile under normal conditions. But what of its discharge under *pathological* conditions. It must be admitted that the factors underlying the alterations in the composition of the bile are still imperfectly understood. That these factors are influenced by conditions outside the liver is almost self-evident; conditions that alter the concentration in the blood of the materials from which the liver forms the special constituents of the bile; increased cholesterol content of the blood during pregnancy and other conditions; the increased concentration of hemoglobin in the blood plasma from the increased destruction of red blood corpuscles in certain diseases of the spleen and bone marrow; these are examples. Factors that also must be taken into consideration are changes in the liver cells themselves, such as degeneration from the

effects of poisons and of chronic inflammation and exhaustion from overstimulation. Much painstaking work must still be done along these lines before more definite conclusions can be reached, but it is on such investigations that future progress in this direction must depend.

The next unit in the biliary system is the arrangement of ducts that carry the bile from the liver to the intestines. For practical reasons we will deal at this time only with the intra- and extra-hepatic ducts and the common duct, leaving the cystic duct to be considered with the gall-bladder, of which, in a physiological sense, it is a part. Under normal conditions this system serves merely for the transportation of the bile from the liver, where it is manufactured, to the intestinal tract, where it is to be used. It adds nothing to the bile and it takes nothing away. It must be remembered, however, that at the distal end of the common duct there is a sphincter muscle which bears the name of Oddi, who first described it. It is this sphincter that is perhaps the most important part of the whole duct system. Its resting state is one of tonic contraction, and it is this fact that causes the discharge of bile into the intestines to be intermittent one, although its secretion by the liver is a continuous process. It is under direct nervous control and the stimulus to its relaxation is a reflex excited by the presence of certain substances in the duodenum. The physiological stimulus to the relaxation of the duct is the presence of certain foods or their products, the most active being the proteoses and peptones in an acid medium, although fats also cause a relaxation, as witness the protracted flow of bile following the introduction of olive oil into the duodenum as pointed out by Luckie. (17) It is true also that many other substances will cause a relaxation of the sphincter, these substances ranging all the way from warm water to hypertonic solutions of many different salts. (3, 4) Meltzer (13) was the first to point out the relaxing effect of the local application to the duodenum of a solution of magnesium sulphate, and at the same time he propounded the theory of the contrary innervation of the sphincter muscle and the muscular tissue of the gall-bladder wall.

The principal interference with the normal functioning of the bile ducts and the sphincter comes from obstruction arising somewhere along their course. This may occur at any point, but is far more common in the common duct at or near the ampulla, as the result of the lodgment of a stone. Following such an obstruction to the flow of bile, and, in fact, following obstruction to the common duct from any cause, there is a dilatation of the portions of the common and hepatic ducts above the obstruction varying directly with the completeness of the obstruction and the length of time that it took to establish the obstruction.

There is another type of obstruction that originates at the proximal end of the duct system. This is an obstruction to the flow of bile in the finer radicals of the bile capillaries, and it is thought that in certain cases it is due to the production by the liver cells of a thick viscid bile that is unable to pass along the bile canaliculi. (5) This type of obstruction may be the result of either an increased production of one or more of the precipitable constituents of the bile or some dysfunction of the liver cells that permits of an undue precipitation of the bile pigments either in the cell, thus clogging the intracellular currents, or just outside, thereby blocking the finest biliary radicals. In either type of obstruction the result is the absorption of the pigment and other constituents of the bile into the body fluids and their final excretion in the urine. The question as to whether this absorption takes place through the lymphatics or through the capillaries of the rich blood supply of the liver is one that is complicated by the difference of opinion among anatomists as to whether there are lymph spaces in the perivascular sheaths of the smaller bloodvessels of the liver. From the standpoint of experimental physiology there is also a difference of opinion, certain investigators believing that the biliary pigments are absorbed by way of the thoracic duct; Harley (8) stating that if the thoracic duct is ligated at the same time that the common duct is cut the appearance of bile in the urine will be delayed for from fourteen to seventeen days. On the other hand, other investigators agree with Whipple and King, (18) who believe that the route of absorption is by way of the hepatic capillaries. The last-named experimenters state that "The presence of a thoracic duct fistula influences in no way the development of icterus after the total obstruction of the common bile duct."

The *pathological-physiology of the sphincter of Oddi* is seen in connection with pathological states at other points in the gastrointestinal or biliary tracts generally as a relaxation which allows the discharge of bile to be a continuous one. This was well shown in a series of my cases in whom there was proved pathology, such as ulcer or cholecystitis in the duodeno-biliary zone or an appendicitis, for a far greater percentage of these cases showed gross biliary regurgitation into the fasting stomach and bile in the fasting duodenum than normal cases. Further, those that had had previous operative interference showed an even greater percentage of incontinence of the sphincter of Oddi than the cases that merely showed pathological changes. I believe also that as our methods of minute diagnosis become more perfected a condition of spasm of the sphincter of Oddi, which may have been the cause in the cases of Homans, (11) in whom there was dilatation of the common duct in the presence of a functioning gall-bladder and in the absence of

stones, will be as well recognized as is spasm of the pyloric muscle. (See Case XXIII, page 572.)

It is concerning the *physiology of the gall-bladder*, however, that more has been written than about any other part of the biliary tract. It is over this point that physiologists, clinicians and surgeons are still arguing, and, although there is by no means a unanimity of opinion, some of the older and more extreme views are being abandoned and certain facts concerning the physiology of the gall-bladder are coming to be accepted. It is no longer generally believed that the gall-bladder is a vestigial organ, such as the appendix, capable of being removed without influencing the economy of the individual; neither is it now generally accepted that the gall-bladder secretes a hormone that influences the production of hydrochloric acid by the stomach. As we have seen, the formation of bile is a continuous process, and so too the resting or interdigestive state of the sphincter of the common duct is one of tonic contraction. From this it will be seen that during this interdigestive phase the bile must back up into the gall-bladder. One function then of the gall-bladder is to act as a reservoir for the storage of bile until it shall be needed in the process of digestion. But the liver secretes approximately 1000 to 1500 cc of bile during the twenty-four hours, and the average capacity of the gall-bladder is not more than 45 to 70 milliliters. It is evident then that there must be some mechanism by which the bile, as secreted by the liver, can be reduced in bulk so as to be comfortably contained in the gall-bladder. The most recent and authoritative work on this particular question has been done by Rous and McMaster, (15) who have again called attention to the concentrating function of the gall-bladder and have shown that it has the power to concentrate eight or ten times its volume of liver bile in but a few hours.

But even with this power of concentration and storage the gall-bladder must empty itself or become overdistended with static bile. The normal stimulus to this emptying of the gall-bladder is the passage of the products of gastric digestion across the duodenal mucosa, and therefore it is dependent on a schedule of eating that will not allow the gall-bladder to become overdistended. In this country, and indeed with most civilized peoples, food is taken three times during the day at approximately five-hour intervals with a fast during the night of about twelve to fourteen hours. This custom is therefore based on the soundest physiological principles. The fact that the ingested food does not reach the duodenum for from one to three hours may be the reason why so many attacks of colic in gall-bladder disease occur within that time period, for it is then that the gall-bladder is being emptied of its contents and there is motion in the inflamed wall. Also the long fast during the night

producing overdistention accounts for the frequency of gall-bladder colic attacks during the small hours of the morning. Alvarez, (1) speaking of distention of the bowel, has pointed out that "distention of smooth muscle generally causes it to contract more actively," and it therefore seems probable that the slow stretching during the night of the muscle bundles in the gall-bladder wall may result in their sudden spasmodic contraction and a colic attack. In lesser degrees of gall-bladder inflammation or in the absence of stones this nocturnal overdistention may be the cause of the early morning or before breakfast nausea so frequently noted clinically as a symptom of gall-bladder disease. From the above it can also be seen what an important factor the *skipping of meals* may play in the production of an atonic gall-bladder with static gall-bladder bile, and hence indirectly in the production of gall-stones. These two functions of concentration and storage are, I believe, the most important ones.

Granted that the gall-bladder concentrates and stores bile until needed, when that need arises how does the gall-bladder empty itself? It is probable that the gall-bladder is never *entirely* emptied of its contents, due partly to the physics of its situation in the body and partly to the inefficiency of the mechanism of its discharge. As was seen in the discussion of the anatomy of this organ, the muscular layers of its wall are very thin, and as pointed out by Freese, (6) "the maximum force of contraction exerted by the gall-bladder does not exceed materially the maximum secretion pressure of the bile." This degree of muscular contraction, therefore, cannot be of very great importance in the normal physiological emptying of the viscus. Sweet (17) believes that the gall-bladder is emptied by a combination of pressure of the congested and distended neighboring viscera and the milking action on the ampulla of the waves of muscular contraction that are passing over the duodenum. Certain it is that the filling of the gall-bladder is a passive process so far as that organ itself is concerned and certain it is that there is a considerable amount of elasticity in the wall of the gall-bladder, and therefore when the pressure that forced the bile into the bladder is removed by the relaxation of the sphincter of Oddi, that same elasticity would cause the gall-bladder, at least partly, to empty itself. Therefore, we should not expect to see waves of peristalsis passing over the fundus of the gall-bladder such as we see passing over the stomach, but rather as Sachs (16) has described it, we would see the gall-bladder "collapsing as a balloon when the air is slowly allowed to escape." Bearing in mind these various theories I believe that the emptying of the gall-bladder is not the result of the exclusive action of any one of them, but rather the result of the action of a combination of several, perhaps the least important of

them being direct muscular contraction of the fibers in the gall-bladder wall.

So far we have been considering the physiology of the various units of the biliary system. Let us now consider the system as a whole, both as to its physiology and its pathological-physiology. When functioning normally the bile, continuously secreted by the liver, passes down the common duct until it meets the resistance of the contracted sphincter of Oddi, then as the intraduct pressure rises the bile flows up the cystic duct into the gall-bladder. Here a process of concentration takes place by the removal from the bile of water and the addition of a certain amount of mucus. The removal of the water is carried out through the rich lymphatic network in the wall of the gall-bladder. This concentrated bile remains in the gall-bladder until such time as acid chyme passing over the duodenal mucous membrane causes a reflex relaxation of the sphincter of Oddi. Relieved of the positive pressure amounting to the secretory pressure of the bile, the gall-bladder empties itself by the combined action of the pressure of surrounding organs, the elasticity of the gall-bladder wall and a certain amount of muscular contraction.

In considering the *pathological-physiology* of this system, the two chief conditions that have to be considered are obstruction to the common duct and removal of the gall-bladder. Under removal of the gall-bladder, I would include not only cases of surgical removal of the viscus, but also those cases in which it is rendered physiologically functionless by some other condition, among which may be mentioned obstruction of the cystic duct by catarrhal inflammation or calculus, filling of the lumen of the gall-bladder by stones or inspissated bile, or disease of the wall of the gall-bladder rendering it incapable of further dilatation or contraction. In the first instance the obstruction is generally the result of the lodgment of a stone in the common duct, but obstruction from other causes, such as carcinoma of the head of the pancreas or stricture of the common duct are not uncommon. In obstruction of any type the results are the same, namely dilatation of the entire duct system and the eventual absorption of bile into the systemic circulation. The degree of dilatation is dependent not on the cause of the obstruction, but on the time that was taken to establish the obstruction. The dilatation in the ducts above an obstruction that has developed slowly will be far greater than the degree of dilatation above a suddenly impacted gall-stone. If the gall-bladder is still functionally sound and is connected with the ducts above the obstruction the material that collects in the dilated ducts will be a thick, black, tarry bile due to the fact that the gall-bladder will continue to extract water from the bile collected in the system. If, however, the gall-bladder is

not connected with the system, either due to its removal or to obstruction of the cystic duct, the material that collects in the ducts will be a white mucoid material. (15)

The effect of removing the gall-bladder often interferes seriously with the normal physiology of the biliary system. Deprived of the mechanism for the concentration and storage of bile during the interdigestive period the bile secreted during this period collects in the extrahepatic ducts causing these to dilate. This dilatation continues so long as the sphincter of Oddi remains competent, but when, as sooner or later happens, the sphincter muscle becomes exhausted and is overcome, the normal intermittent discharge of bile into the intestine is changed into a continuous one. This state of affairs may be the cause of grave disturbances in certain cases, depending on whether or not the intestinal tract can compensate for the change in the physiology.

There is one other point in this connection that has to do with the question as to whether the gall-bladder is or is not a functionless organ. When the gall-bladder is surgically removed by a high ligation of the cystic duct there is frequently an attempted regeneration of the gall-bladder (9) and there also occurs a dilatation of the extrahepatic duct system. If the gall-bladder were in reality an organ without purpose or function there would probably be no attempt on the part of nature to restore it both anatomically and functionally.

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CHAPTER III.

PHYSIOLOGICAL CHEMISTRY OF THE BILE.

From a physiological standpoint bile is a very complex fluid. As we have seen it plays a very important part in intestinal digestion and if it is entirely excluded from the intestinal tract either in man or the experimental animal (2) death will follow in a short time, although the fatal outcome can be retarded by proper diet. Bile is an excretion as well as a secretion and this fact adds to its complexity as compared to the other digestive fluids. The following table (4) will illustrate the complex composition of bile and also the difference in the composition of fistula bile and gall-bladder bile.

100 parts contain—	Gall-bladder.	Bile from	Fistula.
Water	86	97	
Solids	14	3	
Organic salts (bile salts)	9	0.9 to 1.8	
Mucin and bile pigment	3	0.5	
Cholesterol	0.2	0.06 to 0.16	
Lecithin and fat	0.5 to 1	0.02 to 0.09	
Inorganic salts	0.8	0.7 to 0.8	

In the above table it will be noted that the gall-bladder bile contains about 14 per cent of solids and the fistula bile only 3 per cent; this is accounted for by the concentrating activity of the gall-bladder as pointed out in the previous chapter. It will also be noted that in the gall-bladder bile the inorganic salts constitute but a small part of the total solids, whereas in the fistula bile they form some 25 per cent of the solid matter. This is explained by the fact that when the bile is lost to the body by being discharged through a fistula little or none of the bile pigment and bile salts reach the intestine to be resorbed and sent back to the liver. The liver then can only excrete that amount of these substances that it can form *de novo*. This difference is only noted in those fistula cases in which the common bile duct is obstructed. From the above table it will also be noted that the bile contains no ferments or proferments. Let us investigate each of these components of the bile and see from what they are derived, what purpose they serve and what final disposal is made of them.

BILE SALTS.

What are known as the bile salts are the sodium salts of glycocholic and taurocholic acids. These acids, the bile acids, are pro-

duced only in the liver and consist of a part common to both, cholic acid, combined on the one hand with glycine, and on the other with taurine. It is the cholic acid that is the substance manufactured by the liver, the glycine and taurine occurring in other structures.

The origin of cholic acid is not clear, although it is probably not formed from cholesterol as supposed by some investigators. It is the cholic acid also that determines the level of bile acid formation in the fasting animal, and the fact that bile acids are excreted by the fasting experimental animal suggests an important endogenous factor in the metabolism of this constituent, as has been pointed out by Whipple. (5) That there is also an exogenous factor is seen in the change in the level of excretion on a change in diet, an increase in protein causing an increase in bile acid excretion. Another point emphasized by Whipple is that bile acids administered by mouth to a bile fistula dog will be eliminated quantitatively in six hours. Taking these three facts into consideration—endogenous production, exogenous production and quantitative absorption and later reëxcretion—it will be seen that there must be some factor regulating the metabolism of this substance, but just what this factor is has not as yet been sufficiently explained.

The bile salts are the most important part of the bile so far as the process of digestion is concerned. They aid in the digestion and assimilation of fats in the intestine; they accelerate the action of lipase on the emulsified fats in the intestine probably by lowering the surface tension and bringing the water and fat into close contact. After the hydrolysis of fat into fatty acid and glycerin the bile salts form a loose chemical union with part of the fatty acid and in this form pass into the epithelial cells lining the intestinal tract. Here the labile union is broken down and the bile salts set free to be carried back to the liver where they stimulate a further secretion of bile and are themselves reëxcreted, thus forming what is referred to as the "circulation of the bile." The absence of bile from the intestinal tract results in a faulty absorption of the fatty acids and these appear in great amount in the stools.

Another most important function of the bile salts is their ability to keep the cholesterol of the bile in solution. Again it is the cholic acid fraction of the bile salts that is active in this respect and the importance of this fact will be seen when we realize that the cholesterol of gall-stones constitutes from 20 to 90 per cent of the total weight.

CHOLESTEROL.

The next most important constituent of the bile is cholesterol. It is present in but very small amounts, but is of great importance

clinically due to the fact that when it is precipitated it crystallizes on any suitable nucleus and forms gall-stones. Cholesterol is a monatomic alcohol with at least one double bond. It occurs in nervous tissue and in the membranes of red blood corpuscles, being found free and combined as an ester. Besides this endogenous cholesterol there is also a certain amount of exogenous cholesterol derived from the food. The amount found in the bile is to be considered as an excretion from the liver, the liver being the pathway of elimination chiefly because of the associated formation of bile salts which have a solvent action on cholesterol and serve to carry it out of the blood.

Much remains to be done in this branch of physiological chemistry especially in relation to pathological states of biliary chemistry and their relation to the formation of gall-stones. One of the most interesting questions is the relation of the concentration of bile salts and cholesterol in the bile to the precipitation of the latter. I have found that in certain biles there may be a high concentration of cholesterol and yet no microscopical evidence of crystallization, and in others the concentration may be considerably less and yet a precipitation of the cholesterol is seen under the microscope and gall-stones are found at operation. In the latter case was it an insufficiency of bile salts that allowed the precipitation of cholesterol from a relatively low concentration?

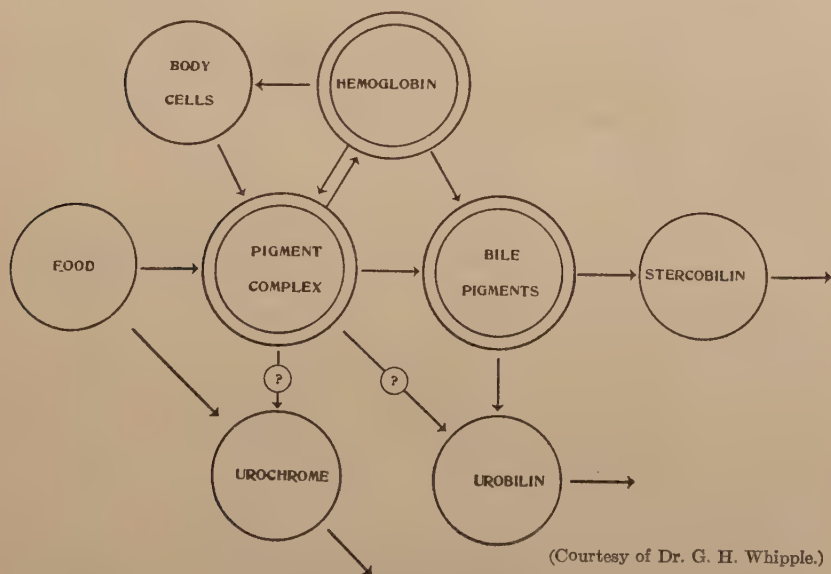
BILE PIGMENT.

Of all the constituents of the bile the biliary pigments have received the most exhaustive study and have been the subject of extensive research investigation. In spite of this, however, there are many questions regarding their metabolism that are far from clear. The principal pigment is bilirubin, from which by oxidation a series of other pigments, biliverdin being the most important, are produced. Upon the reduction of bilirubin there is produced a pigment, urobilin, that is the chief pigment of the urine.

It was formerly believed that bilirubin was only formed in the liver and that it was derived exclusively from the breaking down of hemoglobin. In recent years, however, experimental evidence has been brought forward by various investigators (3, 6, 7) that bile pigment can be formed by other tissues without the aid of the liver and also that there may be other sources of bilirubin than the hemoglobin released by the destruction of erythrocytes. These men have shown that bile pigments will appear in the blood stream after complete exclusion of the liver and also that hemoglobin introduced into the large serous cavities is changed into bile pigment. It seems probable that the vascular endothelium and serous mesothelium

are responsible for this change. Whipple and Hooper have also shown that bile pigment elimination can also be increased in fistula dogs, at times to an extent of 50 per cent, by a change from meat to carbohydrate diet.

There is no doubt but that the major portion of the bile pigment excreted is formed by the hepatic epithelial cells from hemoglobin, but under certain circumstances other sources both of origin and production may play important parts. Whipple and Hooper (7) have shown that hemoglobin injected intravenously is not quantitatively excreted as bile pigment, but that part is used by the body. The amount converted into bile pigment probably depends on the needs of the body for hemoglobin, as it is known that blood or hemoglobin aids greatly in the recovery from simple anemia. This injected hemoglobin is not used directly, but, as Whipple (5) has pointed out, is first broken down into what he terms "pigment complex." Fig. 50 is used by Whipple to explain his conception of the part played by the food, the body cells and hemoglobin in the production of body pigments.



(Courtesy of Dr. G. H. Whipple.)

FIG. 50

Whipple also says, "All the evidence at hand indicates that the pigment substances in bile (bilirubin, biliverdin and urobilin) subsequently serve no useful purpose and are true excretory substances. There is no evidence for any 'circulation' of the bile pigments and

when this word is used it should be limited to the bile salts which are so rapidly absorbed from the intestine."

The *lecithin* and *other fatty substances* that are present in the bile are probably derived from the breaking down of the red blood corpuscles in the liver. They are present in very small amounts and appear to be of little or no practical importance. The *inorganic salts* that are present are of more importance because they are incorporated at times in gall-stones. Calcium is the principal salt, although traces of the heavy metals have also been found in the bile.

Most authors state that the calcium is present as phosphates, but of interest in this connection is a point brought out by me in a recent investigation on gall-stones. The stones under investigation had been demonstrated by the roentgen ray, and therefore contained appreciable quantities of calcium. When a small fragment of these stones was macerated and examined under the microscope a preponderance of small, colorless, oblong crystals were found in association with a certain amount of bile pigment and cholesterin. When this material was added to dilute hydrochloric acid, effervescence of the fluid occurred, and when the remaining sediment was again examined under the microscope the crystals noted before were not found and only cholesterol and bile pigment were left. From this it would seem that the calcium had originally been in the form of the carbonate.

TABLE I.—EXAMINATION OF BILE DISCHARGED SPONTANEOUSLY INTO THE DUODENUM.

	Amount.	Color.	Specific gravity.	Acidity.
1	60 cc	Golden	1.015	50°
2	10 "	Golden	1.040	25°
3	30 "	Golden	1.013	25°
4	20 "	Golden	1.022	25°
5	45 "	Golden	1.018	45°
6	25 "	Golden yellow	1.022	10°
7	20 "	Dark golden	1.024	10°
8	20 "	Golden	1.022	40°
9	40 "	Golden	1.022	20°
10	20 "	Golden-brown	1.014	20°
11.	40 "	Golden	1.012	20°

One other point in bile chemistry that I would like to mention is in regard to the reaction of the bile. It has been generally believed and taught that the bile is alkaline, but this I am coming to believe is not the fact. Table I illustrates this point. These cases were unselected except that only cases were used in which there was spontaneous discharge of bile into the duodenum without the use of any stimulant. It will be seen that in all these cases the bile was

acid to phenolsulphonephthalein, although there was no free hydrochloric acid present, and the bile was transparent. This acidity ranged from 10° to 50° , but seemed to bear no relation to either the color or the specific gravity. Fitz, (1) of the Mayo Clinic in one of their staff bulletins, mentions his observations on the reaction of bile. He found that bile from the gall-bladder has an acid reaction and is not the strongly alkaline fluid recorded in various text-books.

I believe that the acidity of the bile may be due to its contained bile acid salts, and that the acidity may vary somewhat in proportion to the variability in the bile salts.

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CHAPTER IV.

A BRIEF SKETCH OF THE HISTORY OF GALL-TRACT DISEASE FROM THE FIFTH CENTURY AND ITS MANAGEMENT.

GALL-TRACT disease, although apparently known to the ancients, and mentioned in the literature of the Middle Ages, and attributed to various and erroneous causes, was imperfectly understood until many years after the development of the science of anatomy introduced by the great Andreas Vesalius in the sixteenth century.

Being the largest organ in the body, it is natural that the liver (and its excretory apparatus) was suspected by the ancients of being involved in the production of many diseases. Although many shrewd guesses were made, more accurate knowledge had to wait upon the development of the beginnings of anatomical studies and postmortem investigations crudely and imperfectly conducted three or four centuries ago.

A very thorough search into, and digest of, the historical literature of this subject will be found in a treatise on gall-stones published by a very erudite English physician named Thudichum (5) in 1863, to whom I express my indebtedness for liberal extracts from his book, which is presented in a most interesting fashion.

Thudichum found that the earliest notice of concretions in the liver, which, with certain reservations, may be explained as gall-stones, occurred in the work of a Greek physician named Trallianus Alexander, who lived and wrote in about the fifth century A.D. His work, written in Greek, was lost for over a thousand years and was not published until 1548. Alexander refers to "dried up humors, concreted like stones," which he found, either from personal observation or from information derived from others, to now and then occur in the liver.

It was not until four centuries later that the next reference to gall-stones appears in medical literature, when Rhazes, the Arabian physician, in his writings about 900 A.D., refers to the gall-stone of the ox, and says (quoted by Gesner, 1602), "In the gall of the ox something resembling a stone, of the shape of a ring is found, which philosophers call alcheron; ground and drawn into the nostrils, it promotes the sharpness of the eyes, etc. If this alcheron cannot be had, a sesquidenarius of the bile of a black bull may be substituted."

And Gesner adds, "That alcheron, a hard, stone-like substance, which is found in the bile of cattle, is useful to those who suffer from epilepsy, and promotes the sharpness of the eyes, and prevents that any humor collects in the eyes, we have taught above, in speaking of the ox, according to Rasis."

About 1000 A.D., Avicenna, an Armenian physician, wrote "Gall-stone of the ox. What is an ox gall-stone? It is a stone which is found in the gall-bladder of the ox, of the size of a hen's egg, and of a citron-yellow color, drawing toward the red; and it has a bitter taste, biting the tongue; and it is of a light weight; and if it remains for a long time, it becomes broken up." Avicenna's work contains references to Europsus, who also recommended gall-stones in epilepsy, and to Galenus, who found them of little use, except for the head.

At this period gall-stones were evidently looked upon as an accidental formation, without any reference to disease. And it was not until 1507, or about five hundred years later, that the fact that gall-stones produce disease became known to Benivenius, a celebrated Italian physician at Florence. He wrote a treatise, "On the Hidden Causes of Diseases," and to him we are indebted for the first observations on gall-stones occurring in the human subject. It is interesting to us to realize that, in this period of dawning knowledge, the earliest case reports dealing with this subject more particularly allude to the occurrence of *liver* stones, rather than to those occurring in the gall-bladder. This means that recognition of the disease was very late, after biliary stasis had taken place within the ducts and within the liver substance itself. Today it is exceedingly rare for us to find liver stones.

It is worth while to quote some of the case reports which occurred in the writings of Benivenius, published in one of the later editions about 1621, with comments by Dodens (Dodonaeus), a professor at Leyden, who flourished about the year 1588.

"*Stones Found in the Membrane Surrounding the Liver.*—A certain noble lady had been suffering greatly and for a long time from a pain in the situation of the liver, and although she had consulted a great many physicians, she had not been able by any remedy to get rid of her malady. For this reason she was pleased to try our aid, together with that of others. We met several physicians, and discussed at great length on all sides what might be the hidden causes of the disease. However, as happens frequently in doubtful matters, we could not agree to a verdict, for some had supposed an abscess of the liver, others a degeneration of that organ; we ourselves, however, believed that the fault was with the covering membrane. When she, after a few days, during which the illness increased upon her, had departed this life, as we had, from the certain signs, foretold by common consent, we procured the opening of the dead body. And

there were found small stones, differing in shape and color, which had been collected in the lower part of the membrane of the liver. Some stones were round, others angular, others quadratic, as position and accident had effected it; some had red spots, others were distinguished by blue-and-white ones. By their weight they had formed of the covering of the liver a small sac, of the length of the hollow of the hand, and of the width of two fingers. As we believed these to have been the cause of death, we judged it vain and useless to dispute on obscure matters."

Annotation of Dodonaeus.—"It sometimes happens that stones are found in the gall-bladder, as is stated below in the 94th Chapter; but that the membrane of the liver becomes relaxed, and stones are hanging down in that, is one of the rarest occurrences. I recollect to have seen the livers of some who had fallen from icterus into ascites so hard, and so full of little stones everywhere, that they could not be cut through with the knife. Andreas Vesalius, in his letter to Roelants, on the China root (smilax, a kind of sarsaparilla), relates something similar of a certain Belloarmatus, a Senensian, whose liver was found entirely white, and not of an even but of a very uneven surface, and roughened with projecting tubercle; the front part, however, and the entire left lobe were indurated like a stone."

Thudichum, in commenting on the cases of Dodonaeus, very properly stated that they look more like cases of cirrhosis of the liver than instances of liver stones, and criticized the inaccuracy of his quotation from Vesalius inasmuch as he omitted to refer to the 18 gall-stones found in the gall-bladder of this case recorded by Vesalius. Later on Thudichum says, "If the account of Benivenius's first case might make the reader suspicious that he was ignorant of the existence of a gall-bladder in man, and mistook it, filled with calculi, for a morbid formation, this suspicion will be set at rest by the perusal of his second case, which in Chapter 94 is thus related:

"*A Calculus in the Gall-bladder.*—There died in these days a noble lady, of the name of Diamantes, struck down with the pain of stone (in the bladder). But as she had not before suffered any injury from it, the physicians thought well to open the body, and there were found very many stones; none, however, in the (urinary) bladder, as was believed, but, with the exception of one, of a black color and the size of a dry chestnut, which was contained in the gall-bladder, all the others were in the skin by which the liver is covered, out of which they had formed a little sac, in which they were hanging as in a bag. As we believe that this was the cause of death, we concluded that it was the prudence of a wise man to make himself no opinion at all about the uncertain and occult diseases." *Annotation of Dodonaeus.* "Calculi which have been formed in the gall-bladder

we have ourselves also observed. Those (who suffer from them) become of a yellowish color, are troubled with nausea and disinclination to food, and are long in bad health."

That the true cause for the formation of gall-stones was imperfectly understood during this early period is evidenced by Thudichum's mention of a similar case recorded by Peucerus. "We recollect that a large stone was taken out of the liver of a friend (who had died at Paris and been eviscerated), which by its livid-yellow color showed that it had been coagulated in part from phlegm, in part from melancholic humor."

The next further step in acquiring more accurate knowledge came about through Fernelius, physician to the king of France (and a contemporary of Vesalius and Fallopius), who, in addition to being the first to observe the expulsion of gall-stones by the spontaneous efforts of Nature, also advanced the first relatively modern hypothesis regarding the origin of gall-stones, and mentioned some of the symptoms which they could produce.

In his book, "*De morbis universalibus et particularibus*," which he wrote about 1558, and the second edition of which was published in 1645, he states, "Sometimes also yellow bile, which has been, contrary to Nature, longer retained in the liver, and not been cleared out at the proper time, becomes very thick, and induces serious and very dangerous obstructions of the liver, so that (as we shall presently show) it becomes at times even transformed into stone in the gall-bladder."

And in a later chapter in his book he writes, "Sometimes a calculus grows in the gall-bladder, which is black, but light, and when immersed in water it floats upon it, and does not sink in it like that which is voided from the kidneys or the bladder.

"It originates from yellow bile, which, for a long time retained in its own receptacle, and not evacuated in proper time, and not renewed by an influx of fresh bile, becomes hard to a wonderful degree. This happens particularly when both ducts of the gall-bladder become obstructed.

"Of this there are neither manifest nor grave symptoms known by which it could be detected with certainty and ease. But it must be suspected in those who have had long and serious jaundice.

"Some decrepit old man, who was very much inclined to be angry, was after his death found without bile and without gall-bladder, in the seat of which latter a very large (*ingens*) calculus had become concreted.

"In several who, after prolonged jaundice, became affected with diarrhea we have even observed that innumerable calculi of this kind, like peas or barley-corns, were expelled."

His hypothesis, therefore, is very much more in accord with what

we know today than is that of Joan Kentmann, a Dresden physician, who in 1665 affirmed that bile was burned by the heat of the liver and concentered to a calculus in the gall-bladder. We are indebted to Kentmann, however, for the first really good and fairly accurate description of gall-stones, as follows:

"The stones which form in the receptacle of the bile are in size equal to lentils, peas, beans, filberts, the joints of fingers, or even walnuts; in shape one part is round, another angular; the latter are pentagons, or heptagons or octagons, or even of more angles, for the more calculi are found together the more angular they are; all are light like tophi, with a color inclining toward yellow, which, as the stones increase, is changed to yellow. They are moderately hard; broken, they appear inside of a reddish-yellow color, full of narrow circles going round each other, so that everyone can see how slow viscous bile had adhered to the center and to the surface, and has grown gradually around it, and has by the heat of the liver been indurated to such hardness."

In the work of Schenckius, "*Observationum medicinalium volumen*," published in 1609, Thudichum refers to the following passage:

"Horrible and stupendous calculi, coagulated in the gall-bladder; their shape, color, number and wonderful effects, producing vomiting, nausea, heaviness, low spirits, tearings of the stomach and hypochondria, atrophy, tabes, obstruction of the viscera, inflammation, incurable jaundice, sleeplessness, lassitude, sadness and melancholic affections, inclination to anger, difficulty and heat of urine, lepra of the skin, fever, sudden death, by a hidden and generally unknown seminary and foment of diseases and symptoms."

That much of the knowledge acquired during the seventeenth century, as evidenced by the foregoing, was not promptly taken advantage of and developed, is indicated by the writings of Coe in 1757, who says, as quoted by Thudichum.

"Most of the great physicians of the last century just mention calculi, when speaking of the jaundice, as one cause of that disease. Sennertus, Riverius, Etmullerus, Sylvius de le Boe, Willis, Baglivi, and others speak of them in this manner. Some of them, indeed, do observe that, when the jaundice is of long standing and very obstinate, or especially if there have been frequent returns of it, these are signs that it arises from this cause. And this seems to be all that so late a writer as Baglivi knew about the signs of them. He says, perhaps too positively as to the cause, and certainly so as to the incurableness of the disease, 'If you see a pertinacious icterus, or one which relapses after it has got well, you may hold it for certain that it proceeds from calculus in the gall-bladder, and you may predict as incurable what the dissection of the body will teach you.' (*'De Bilis Natura'*)."

"Moreton, a physician of great practice in London toward the end of the seventeenth century, had some knowledge of the intense pains these calculi occasion, though he calls them by the general name of colic pains; and from those pains, joined with the jaundice, he sometimes pronounced that there were stones in the gall-bladder, which were accordingly found upon opening the bodies. But yet he seems to have had no notion of their being discharged by stool, or of any method toward attempting a cure.

"It does not appear that Sydenham, (4) though so careful an observer and so great a practitioner, knew anything at all about these calculi; at least he never once mentions them in all his writings."

Furthermore, as Thudichum states, Boerhaave was well acquainted with the symptoms produced by gall-stones, but not with the issues of the disease. A manuscript copy of his lectures, which Coe saw had the following note, purporting to have been taken from his mouth: "I for a long time wondered what should be the cause of a jaundice preceded by violent anxieties, vomitings, pain, and convulsions, and that all these symptoms should go off, and after a while return again, until at length opening bodies taught me that in these cases the biliary ducts are obstructed by calculi. Hence the bile, not finding a passage, is accumulated to such a degree as to cause those anxieties. But when, by the violent vomitings, the bile is so far exhausted, being partly forced out through the ducts and partly into the vena cava, and from thence all over the body, so as to be reduced to the ordinary quantity, all the complaints cease."

"Some other late authors (says Coe) who knew these calculi well as anatomists, seem to have taken little or no notice of them as practitioners. The celebrated Ruysch was acquainted with them as occurring in dissection, and gives some instances of their being found in opening morbid bodies. He had also seen some that were discharged by stool, but says not a word of any symptoms they occasion, or that he ever had observed them in patients. Morgagni, likewise, that accurate professor of anatomy of Padua, who had seen as many of these calculi as any man, and describes their figures and other properties more exactly than any author had done before him, was very little acquainted with them in living bodies, or aware that they often produce any sensible effects, or are very frequently voided by stool. He knew that some physicians had spoken of their discharge, and even quotes Fernelius for that purpose. And he mentions one calculus that he had seen in the possession of Valisnerius, which was voided after excruciating pains in the stomach, from which instance he seems to have taken occasion to write about them. For he says that as every one who saw it did not know what

it was, he thought it right to give a description of them, that they might be known to others when they are seen to come away. He also criticizes upon the reports of Columbus, Vesalius and Camnicenus, of calculi being found in the vena portarum. These he suspects were really in the bile duct (an assumption which, as the reader already knows, is precluded by the tenor of the reports themselves, and in every respect unfounded).

"At last, when these calculi had been more frequently observed to pass by stool, and the complaints of such patients more nicely attended to, and compared with the circumstances of those in whose bodies they were found by dissection, they came to be taken notice of by more practitioners, and to be more particularly treated of by some few authors than they had been before, who now began to consider and collect the symptoms, and to put them together, as the signs by which such cases might be known."

Even during the eighteenth century Thudichum is able to trace less than twenty doctors who, by their medical writings, can be considered to have contributed any great further knowledge to the subject, and the majority of it is concerned with gall-stones or jaundice, and no definite references are made to inflammations or possibilities of infections.

Among the eighteenth century writers the most important names with the dates of their publications are Bonetus, 1700; Bianci, 1716; Hoffman, about 1720; Vater and Schimmer, 1722; Schacht, 1724; Simpson, about 1725; Van Swieten, about 1725; Ziegenhorn, 1726; Nitzsch, 1731; Boerhaave, 1737; Teichmeyer and Stroehlein, 1742; Wislicen, 1742; Haller, 1756; Coe, 1757; Lieutaud, 1767; White, 1771; Durande, 1790; Petit, 1794; Soemmering, 1795.

Of these men, Simpson, Professor of St. Andrews, was the first to draw any distinction between obstructive and hemolytic jaundice in about 1725; Nitzsch, who first applied crude studies into the chemical nature of gall-stones in 1731; Durande who thought he had succeeded in producing a dissolution of stones in the gall-bladder or ducts by the use of a mixture of sulphurated ether and volatile oil of terebinth in 1790; and, finally, Petit, a famous French surgeon, who first speaks of the possibility of operatively removing gall-stones through a discharging fistula.

Indeed, up to the time of the publication of Thudichum's book in 1863, the nineteenth century is notable for its lack of the appearance of further important dissertations or monographs upon the subject, and Thudichum refers only to those of Powell, 1800, W. Saunders, 1809, Bouisson, 1843, Fauconneau-Dufresne, 1848 and Freirichs in 1861.

I do not pretend in this short résumé of the history of gall-tract disease to have covered any exhaustive search of the literature of the

nineteenth century, but have relied very largely on the book published by Thudichum in 1863. To any one interested in the subject this treatise will be found well worth a close survey, and it will be found that Thudichum has brought us up to the modern threshold of the subject.

Therefore, it can be seen that our present knowledge of the cause and effect of gall-tract disease had to wait for the rise and development of the surgical era which is still modern history. The accumulation of medical literature during the past century, and particularly during the past fifty years, since the use of the microscope and culture tube became ascendent, have gradually taught us the role played by microorganisms in the production of gall-tract pathology.

Credit for most of what we more recently have learned is due to the writings of Thudichum, Pasteur, Ehrlich, Quincke, Nothnagel, Naunyn, Kehr, Mayo Robson, Weil, Moynihan, Bland-Sutton, Chauffard, Courvoisier, Hoppe-Seyler, Chiari, Banti, Pavlov and Rolleston, all of modern times. And still more recently to the contributions of Ewald, Herter, Musser, Kelly, Mayo, Brewer, Deaver, Meltzer, Cheney, Smithies, and a host of physiologists, roentgenologists and clinicians.

At first purely *medical* treatment held sway. For a time such chemical and dietetic treatment was directed only to stimulating the flow of bile, preventing it from becoming stagnant and static within the liver and its excretory channels, thus washing out the bile ducts, and to the relief of gastro-intestinal catarrhs by sweeping out the inflammatory, infected and toxic products by way of the bowels.

Thus for years custom and experience sanctioned and advocated the use of so-called cholegogues (such as calomel, nitrohydrochloric acid, bichloride of mercury, podophyllum); saline cathartics, (magnesium sulphate, sodium sulphate and phosphate); vegetable cathartics (rhubarb, senna, aloes, cascara); vegetable hydrogogue purgatives (colocynth, gamboge, jalap, elaterin, bryonia, leptandria, iris).

Spa treatment became popular, and the more so when Fashion lent its dictates. It became the vogue to take an annual or biennial "cure" at Carlsbad, Marienbad or Kissingen in Austria; at Hamburg, Neuenahr or Ems in Germany; at Vichy or Brides in France; at Harrowgate, Bath or Llandrindod in England; or at French Lick, Indiana; White Sulphur, West Virginia; Bedford or Sharon, Pennsylvania; Los Vegas, California; or Saratoga, New York. The waters of these springs are all rich in the saline cathartics mentioned above, especially magnesium sulphate.

It has been recently recognized that while these measures do aid

in draining the liver, flushing its ducts and purging the intestines, they fail to act upon the gall-bladder.

Meltzer (see next chapter) taught us the difference between the constricting and relaxing effect that sodium sulphate and magnesium sulphate exert upon unstripped muscle. It is the latter that is most effective, but when taken by the mouth and allowed to pass through the stomach it is altered by the normal acidity of the gastric juice, and after reaching the duodenum is converted to a large extent into sodium sulphate, which constricts instead of relaxes involuntary muscle.

To give a chemical example: a 1 ounce saturated solution of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ contains about 20 grams of salt. If the stomach contains about 100 cc of residuum, it contains about 0.25 gram of HCl , about half of which (0.1 gram) might go to form 0.3 gram of $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ and liberate 0.15 gram of H_2SO_4 . The H_2SO_4 passing into the intestine would be neutralized by the NaHCO_3 of the pancreatic juice and bile, forming about 0.5 gram of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$.

If regurgitation into the stomach takes place, some sodium sulphate might be formed there. The figures given are necessarily rough approximations, and the amounts of MgCl_2 and NaSO_4 found are probably less than indicated.

The chemical equations showing the reactions which take place are as follows:

In the stomach, $\text{MgSO}_4 + 2\text{HCl}$ is converted into $\text{MgCl}_2 + \text{H}_2\text{SO}_4$

In the intestine, $\text{H}_2\text{SO}_4 + 2\text{NaHCO}_3$ is converted into $\text{Na}_2\text{SO}_4 + \text{H}_2\text{CO}_3$.

Later on, as our knowledge grew, chemical therapy was directed to attempts to disinfect the gall-tract (with hexamethylenamin, sodium salicylate, bismuth salicylate); to relieve spasm (with belladonna, benzyl-benzoate, olive oil, sodium oleate or eunatrol); to stimulate further bile secretion and supply deficiencies in its composition (with verocholate, taurocol, glycotaurol, pancrobilin, caroid and bile salts and other proprietary preparations).

Whether or not these measures serve to act directly in emptying the gall-bladder as a part of the gall-tract, they have proved inadequate and only palliative. Primarily this is due to their failure to remove poisoned bile from the body before resorption has taken place through the mesenteric lymph and blood supply as the bile is passing out through the intestines.

The rise of the surgical era in the management of gall-tract disease was therefore due in large part to medical helplessness. Chemical and dietetic therapy had some influence, although meagre, in helping to correct catarrhs or inflammations of the gall-bladder and ducts and to quiet down active or restless gall-stones in an inflamed gall-bladder and bring them back to a state of quiescent

latency. But only the surgeon can remove the stones or cut away the pathological tissue.

Surgery, too, has gone through its changing period of development as the pendulum of opinion and experience has swung. The operative treatment of cholelithiasis has only been generally employed during the last thirty-five years, with steadily improving results in the hands of the best full-time surgeons, due to a parallel improvement in technic.

Hoppe-Seyler (3) gives a historical summary of the surgical development of this subject up to twenty years ago as follows:

"Petit, the first surgeon to attempt opening of the gall-bladder for inflammation following cholelithiasis, limited the operation to cases in which he was positive that adhesions had formed between the gall-bladder and the walls of the abdomen. Even under these conditions a majority of the clinicians of the end of the eighteenth and the beginning of the nineteenth century condemned it. Sharp, Morand, and Haller supported Petit in his views during this time, and Herlin, l'Anglas, and Duchainois attempted to demonstrate their feasibility by experimentally extirpating the gall-bladder from animals without detriment. Bloch went even further than Petit and advised the artificial creation of adhesions between the gall-bladder and the abdominal walls as a step preliminary to the operation of incision. Richter, Sebastian, Graves, Fauconneau-Dufresne, and others made similar suggestions. Thudichum, in 1859, advised sewing the gall-bladder to the abdominal walls as a preliminary step, and opening the viscus after six days. In 1867 Bobbs performed a cholecystotomy, having mistaken the tumor of the gall-bladder for a cyst of the ovary. In 1878 Kocher performed a successful operation for empyema of the gall-bladder, and at the same period Sims operated on a case of cholelithiasis according to the method of Thudichum, with an unfavorable result. After this time Keen, Lawson Tait, Rosenbach, and Ransohoff performed numerous operations for gall-stones. In 1882 Langenbuch was the first to perform extirpation of the gall-bladder (cystectomy), and Winwarter performed the first cholecystenterostomy in a case in which the common duct was occluded. Following these operations, Kuster recommended the ideal operation of cystotomy: viz., cystendesis (Courvoisier). This consisted in opening the gall-bladder, evacuating its contents, closing it again, and replacing it in the abdominal cavity. Of late years the bile-ducts themselves, in cases where the gall-stones were situated within these passages, were incised directly (cysticotomy and choledochotomy). The last operation was usually undertaken from the front of the body; in some instances from the lumbar region. Finally, an operation has been performed several times that consists in making an artificial fistula between the ductus

choledochus and the intestine—choledochoduodenostomy and choledochointerostomy, both of which operations are indicated whenever the common duct is occluded.”

It will be seen from this that although Petit in 1794, apparently first conceived of the idea of surgically removing gall-stones either through a spontaneous fistula or through a tract of adhesions, the first accurately known operation upon the gall-bladder itself (a simple cholecystotomy) was done by Bobbs of Indianapolis in 1867 as a result of a mistaken diagnosis. Although Kuster first recommended the ideal operation of cystotomy in about 1883, McRedit, another American, in 1884 advocated the “Ideal Gall-stone Operation” of simply opening the gall-bladder, removing the stones or sand, curetting the mucosa and sewing up without drainage. This operation is mentioned by later authors such as Moynihan, Robson and others only to be condemned.

As the evidence of the great part that infection plays in gall-tract disease became more apparent to the surgeon, the *era of drainage* began and cholecystostomy and later choledochostomy became the popular operations.

The principle of surgical drainage in infection was sound enough, but later, as relapses occurred, it was learned that the success of this method in most cases was limited by the life of the absorbable suture materials, after non-absorbable sutures had been tried out and discarded. For it was easy to see that the success of this method depends upon three factors: the nature and virulency of the infection and its chronicity, measured in terms of the resistance of the gall-bladder and duct mucosa and walls, and measured again in terms of the efficiency and duration of surgical drainage practised in each case.

In other words, was the amount of infected bile removed from the body, within the average time limit of fifteen to twenty days, sufficient to rid the tract of infection so that Nature could restore the tissues? In many of the milder cases this was enough. In the more severely infected ones surgical relapses occurred in such numbers as to direct attention to the obvious surgical limitations in drainage alone and the *era of cholecystectomies* began.

This was due to a growing belief that the failures to secure a permanently successful result from a cholecystostomy was because the gall-bladder wall had become infected. Therefore, to accomplish a cure meant simply to remove the gall-bladder. The surgical dictum that a gall-bladder once infected remains always infected was for a time generally believed, and the surgical tendency grew to disregard any possible function that the gall-bladder might possess and to consider it a useless appendage like the appendix, which could be removed with impunity.

Attention was directed to the fact that certain herbivorous animals, such as the deer family, and certain other animals to an extent carnivorous scavengers, like the rat, do not possess gall-bladders, and therefore a gall-bladder was not an organ essential to the preservation of life. While this is somewhat begging the question and fails to face the physiological principles at issue, it is nevertheless partly true, for many human beings are living in comfort—often greater than they previously possessed—without their gall-bladder. But too often there result unpleasant and sometimes distressing discomforts (post-surgical protracted diarrhea, duodenitis, reversed peristalsis with biliary reflux into the stomach, often producing persistent nausea), because the physiological mechanism of the gall tract has been disturbed and the process of digestion cannot become compensated to the loss of the gall-bladder.

It is interesting to see how the swing of surgical opinion altered the views of some of the best surgeons. In 1908 no less an authority than Deaver (1) writes:

"To my mind the gall-bladder if not greatly diseased should not be removed unless the cystic duct is permanently and irremediably occluded. With few exceptions when the duct is patulous the gall-bladder should not be removed in acute catarrhal calculus or non-calculus cholecystitis. Nor even in acute suppurative calculus or non-calculous cholecystitis. But comparatively few cases of chronic calculous or non-calculous cholecystitis indicate ablation, unless hydrops, fibrosis, or calcification of the walls of the organ exist."

And in order that his position in the matter might not be misunderstood we find him saying a little later on:

"This question of cholecystectomy appeals to me strongly, as I fear, from what I read and hear, the practice is all too common, and the influence of this teaching upon those who have not themselves had sufficiently large experience to decide for or against removal, will be bad indeed. My experience is that the more gall-bladder surgery I do, the less inclined I am to remove the gall-bladder. I will not touch upon the comparative mortality of the two operations, cholecystectomy and cholecystostomy, but will simply say, in passing, that many lives are lost from hemorrhage, directly or indirectly following removal of the gall-bladder, except when done by the surgeon who is most skilful, most dextrous and whose experience in gall-stone surgery is very large."

And yet in 1920 he has apparently become converted to a belief, equally as positive, in the efficacy of cholecystectomy, for out of a series of 800 cases of gall-tract disease, which he operated during the four years preceding 1920, he did a cholecystectomy in 611, or 78 per cent, and a cholecystostomy in 78, or approximately 10 per cent. (2)

He qualifies his position somewhat, for he says: "For the occasional operator therefore I would suggest doing a drainage operation and not a removal of the gall-bladder. It is better for the patient to run the risk of recurrence of gall-stones than to be left with either a damaged common or hepatic duct, a condition I have had to deal with a number of times, which warrants me in being very emphatic on the subject.

"That adhesions form after a drainage operation is true, but they are neither as dangerous nor as productive of serious trouble as are the adhesions following removal if the operation is not very gently and carefully done."

This paper is well worth a careful reading, for it points out clearly the difficulties and dangers to be met with, not at the hands of the occasional operator, but of the full-time master of surgery operating under the best of conditions in one of the best surgical clinics in this country. The very title of this paper, "Operation and Reoperation for Gall-stone Disease," is very suggestive, and it would have added something toward the clarification of the subject had the mortality table been published.

Therefore something is still wrong. Too many of the patients do not get well and suffer surgical relapses following cholecystectomies and choledochostomies, which again necessitate reoperation. The literature is full of the histories of these multiple operations and reoperations on the gall-tract, and yet it is safe to say that only a fraction of them have been thus recorded.

The surgeons themselves now affirm dissatisfaction with the present status of gall-tract surgery and evidence it by their tendency to further surgical experimentation with cholecystodochostomies, cholecystogastrostomies and cholecystoduodenostomies.

Certainly something is still wrong, but what is it? There are three principal reasons:

First, our methods of diagnosis have so far been unequal to the task of detecting gall-tract disease in the stage of *early* catarrh and infection when it will prove amenable to the method of treatment which will be advocated later in this book, but without which it will progress to later stages of extensive gall-tract pathology, as our previous strictly medical experience has proved.

Second, the surgeon, by virtue of the first reason, in too large a number of instances, has not been sent his patient *early* enough to do a permanently corrective or curative operation. He can do what no other method or system of treatment can do. He can excise pathological tissue provided it is not too extensive. He can remove the gall-bladder, take out gall-stones, release or remove inflammatory adhesions, but he cannot take out the liver or remove the bile ducts and have the patient live—certainly not for long. In other

words, the surgeon has been getting his patients too late and has shouldered more than his share of responsibility, not always through any fault of his own, but more often because the medical adviser has been a diagnostic delinquent or a therapeutic procrastinator.

The third reason, which is again a corollary of the second, is because there has not been developed (until recently) a practical postoperative method of ascertaining whether or not surgery has actually accomplished what it undertook to do, namely ridding the gall-tract of infection; nor a practical method of postoperative treatment which will often ensure a complete initial operative success and prevent the necessity for reoperation. In neglecting to take advantage of the method to be advocated, the surgeon will, in the future, have the burden of responsibility shifted to himself. Certainly the greatest number of failures following cholecystectomies barring surgical imperfections in technic, arise from the fact that the operation has not succeeded in removing infection from the bile ducts or liver and a postoperative cholangitis results. This failure can now, in a large measure, be prevented, as will be discussed in subsequent chapters.

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CHAPTER V.

A PLEA FOR EARLY, COMPREHENSIVE AND COMPLETE DIAGNOSIS. HOW CAN IT BE SECURED?

THERE is probably no six inches of the entire alimentary canal in which states of organic disease are so prone to develop as in the first and second portions of the duodenum; nor is there any zone into which the elements of differential diagnosis enter in a larger and, at times, more perplexing manner. This, the hot bed of digestion, has emptying into it the mixed or mixing secretions from the stomach, the liver, the gall-bladder, the pancreas and the secretion from the duodenal mucosa itself.

The physiology of the digestive secretions in normal people from these various sources has become better understood during recent years. The pathological physiology of states of disease in this zone has been the subject of much profitable investigation during a still more recent period. Some light has been thrown upon the subject by means of carefully conducted animal experimentation. The more widespread use of the duodenal tube in the hands of capable students of gastro-intestinal disease is contributing greatly to our knowledge by clinical experimentation on human beings, both normal and those suffering from disease. We have learned how to interpret our findings in the duodenum much more clearly and accurately; we can quite easily determine states of duodenitis and can differentiate those that are catarrhal, those that are infected, and those which show unusual exfoliation of dead and dying epithelium (see p. 321); we can feel reasonably sure of separating our more superficial erosive states from those of true ulceration simply because we are gradually training ourselves to make better use of the materials recovered by means of the duodenal tube for more painstaking cytological, bacteriological and chemical studies.

Differential diagnosis has been gradually extended so that we are now fairly sure of the soundness of our investigations into pancreatic states of health or disease, although there remains a very great deal of work to be done in this field. We have made, too, considerable progress in our ability to diagnose accurately many of the states of disease of the biliary system. Heretofore, unfortunately, most of our fruitful efforts, as in the cancer problem, have resulted in the elaboration of various methods and various tests that concern themselves in the proving of disease already well established.

Furthermore, our methods of diagnosis have been more largely indirect than direct. We have learned the value of the carefully taken and searching inquiry into the presenting symptoms, we have learned to interpret more clearly the transition of the earlier symptoms into those that in themselves are almost diagnostic, we have extended the scope and the accuracy of our methods of physical examination, and our eyes and our fingers have gradually been trained to take cognizance of more minute abnormalities than would have been thought possible a generation ago. Much of this has come about through the pioneer efforts of the surgeons, who have taught us by object lessons in living pathological anatomy at the operating table, a more correct interpretation of historical syndromes and of data gained by physical examinations.

We have made further progress, too, in the art of diagnosis of various biliary diseases, as we have caught the importance of focal infection and its march from primary to secondary fields of activity. By the more recently accepted methods of examination of blood chemistry we have learned something of the significance of an increased amount of cholesterol in the blood serum; we have connected some of the clinical links regarding the incidence of pregnancy, tight lacing, and other conditions with gall-bladder disease, especially in relation to the formation of gall-stones. As a more direct means of diagnosis we have turned to the roentgenologist for the important aid he can now furnish us with his positive and negative shadows of formed calculi or of increased connective tissue formation in the wall of the pathological gall-bladder. But direct as is the evidence given by the roentgen ray, it fails us, perhaps, in half of our cases, and even when supplied serves only to prove a pathological state *already well established*. In other words, the greater part of our diagnosis of gall-bladder problems, thus far made practical, supplies us with information pointing to disease so fully developed that we have been handicapped in applying methods of treatment which, to be successful in ultimate cure, have become more and more radical.

The field of treatment by almost common consent has fallen to the surgeon because our accepted method of medical management have woefully failed to bring results other than palliative.

For nearly six years I have taken great interest in developing a more direct means of differential diagnosis of diseases of the biliary system which lends itself admirably not only to the direct detection of organic disease well established, but also gives promise of a better understanding of functional disorders of the liver and gall-bladder and the recognition of pathological-physiology which may act as part of the precursory states in the development of the later full blown disease.

We have known for some time that it is possible to drain bile from the common duct and from the liver and collect it by means of the duodenal tube for examinations that have been directed largely to the estimation of pancreatic efficiency. (Einhorn, Gross, Crohn.) But a great step forward was made when Meltzer suggested to us a means of making the gall-bladder "contract" and discharge its contents. This has opened an entirely new field of clinical diagnosis and investigation and has widened the horizon of our vision for the recognition and correction of the *early* states of disease of the gall-bladder and ducts that may ultimately lead us to the goal of present day medicine, namely, the prevention of another group of diseases which has claimed a heavy toll of suffering and death. I allude to gall-stones and serious late states of infection of the gall-bladder, liver and its ducts.

The conception of this method, its rationale, the praise or criticism it has evoked, and its practical application will be discussed at length in subsequent chapters.

In the *direct evidence* it furnishes us it far surpasses any diagnostic method yet available, and materially assists our correct interpretation of the presenting history, the physical examination, and the information furnished by the roentgen ray and by the laboratory examinations into the state of gastric chemistry and motility, and of the stools, urine and blood chemistry. But most important of all, it furnishes direct diagnostic evidence of the *beginnings* of biliary stasis, or masked focal infection that precede the more florid states of biliary disease and give rise later to the symptoms, the physical and laboratory findings that are usually so clear cut as to make a tentative diagnosis of gall-bladder disease quite possible and to warrant the dictum (no longer tenable), "We will do an exploratory operation and find out what the trouble really is." This is all very well for the doctor, but a little rough on the patient if there is another reliable and direct alternative method available.

In other words, we must learn how to find the direct evidence in the early cases exhibiting the chronic but vague dyspeptic symptoms and not leave it to the exploratory operation to decide whether the trouble lies in the upper right or the lower right abdominal quadrant. Even with the stomach, duodenum and gall-bladder well exposed the surgical eye and finger *often fail* to detect the presence of an early cholecystitis, choledochitis or duodenitis (usually the forerunner of ulcer), because there is no recognizable gross pathological change (quite ignoring the pathological-physiology or infection that precedes gross pathology), and the appendix is then removed usually because it presents a sufficiently pathological condition to warrant it. Not infrequently, however, it is quite innocent and is removed simply because the abdomen is open and it doesn't increase the risk of the operation.

What is the result of this? If there is present concomitant disease of both appendix and gall-bladder, as Rosenow's studies lead many to suspect, and if the gall-bladder is harboring streptococci, but in a state of masked focal infection, not severe enough to cause diagnostic symptoms with a parallel gross pathology, but nevertheless sufficient to produce a pathological biliary physiology and a positive bacteriology to be found by him who looks, the result is this: The surgeon explores, and finds no upper abdominal pathological condition, no enlarged glands, no stones, no adhesions and the gall-bladder expels its contents under forcible digital pressure, (but can it do so under its own muscle power?) and because there is no *gross* pathological condition the surgeon says everything is normal here, leaves a gall-bladder harboring streptococci, and proceeds to account for the symptoms by removal of the appendix.

The patient gets well, that is to say, he recovers from the operation, his symptoms improve temporarily, aided by his hospital rest and the removal of his appendix, provided it was in a truly pathological condition; but usually between six and twenty-four months later his symptoms recur, progress in frequency and severity, and change in character until finally the clinical picture of full blown gall-bladder or duct disease presents itself and in the judgment of most doctors operative interference again becomes imperative.

This is not to be wondered at, for it doubtless is true that operative interference has been the best procedure when conducted by the properly skilful hands.

The surgeons have been successful pioneers in the field of gall-bladder therapy because the indirect efforts of the internist with his cholagogues and bile disinfectants, his medicated waters, his diets and his prescription to attend expensively famous foreign spas have been inadequate and uncertain, whereas the direct attack by the aseptic scalpel is productive of prompter results whether good, bad, or indifferent.

As one authority, (3) so apt always in his quotations and epigrams, says, "If thy right hand offend, cut it off." But let us pause a moment and consider. Of course it is easy for the skilful surgeon to cut it off, but it is quite another matter to put it on again if the first experiment doesn't work. It is one thing to remove with impunity the appendix which possesses no (or an unknown) function, (although many an innocent one has been removed in the past, as have healthy tonsils and teeth during their respective crazes), and quite another thing to remove ruthlessly and routinely *every* gall-bladder because some harbor streptococci in their lymphatic tissue and in their walls. As I have said it is all very well with the patient if it works. But suppose, and we all know that this often happens, suppose the common duct remains infected after surgical

drainage is completed and later becomes obstructed, what happens then when the distensible reservoir for liver bile has been removed? The safety valve has blown off. The common duct dilates and vicariously tries to assume the duties of the gall-bladder; diverticuli may appear, duct bile becomes static, new concretions form, and sooner or later the secreted bile dams back into the liver and biliary cirrhosis has begun.

One has only to peruse some of the better recent papers on gall-bladder surgery to realize that operation means facing undeniable risks. Although the mortality has been steadily reduced it was nearly 6 per cent in the 1000 cases analyzed by Smithies, (4) with 35 per cent of associated pathological lesions of the upper abdomen found at operation (enlarged lymphatic glands, acute and chronic pancreatitis, enlarged liver and peptic ulcer), indicating late diagnosis with well established pathological conditions.

Added to this are the complications pictured by the surgeon, the skilled full-time operator and not the occasional surgeon, of damage to the hepatic and common ducts, the recurring adhesions, the persistent fistulas, the occasional fatal bleeding from the liver or from an accidentally torn bloodvessel, the occasional traumatic puncture of the gut, or the spilling of infective streptococcic bile with resultant peritonitis, to say nothing of Nature's recurrent complications of new stone formation in dilated common ducts again obstructed, necessitating recurrent operations, and we have a true picture of the gall-bladder problem as it stands in the light of our present methods of diagnosis and treatment. Certainly it is far better than it used to be, but is it as good as we can make it?

I believe not. What has been lacking has been the development of a method that will detect, on the one hand, the presence of incipient disorder or early disease in the gall-tract, by adding direct diagnostic data to a doubtful history, physical or roentgen-ray examination, and a method which, on the other hand, will furnish an alternative therapeutic plan of management for the early case and will assist the surgeon in the preoperative and postoperative treatment of the more advanced states of pathology, and will therefore by our combined efforts aim to make one operation suffice in curing the patient.

In a critical study of a very excellent paper published by William Fitch Cheney in the *American Journal of Medical Sciences*, October, 1920, on the "Diagnosis of Gall-bladder Disease," I was very much impressed with the favorable case he (entirely unwittingly then) made out for the value of studying the upper right quadrant group of patients by duodeno-biliary drainage. Any impartial reader of this earlier paper by Dr. Cheney will probably realize that he has truly stated the facts in regard to his classification of his first three

groups, based upon a diagnosis determinable alone upon a carefully taken history, physical examination amplified by the roentgen ray and the simpler routine laboratory studies of the stomach and the stools.

Permit me to quote from and comment on a paragraph from this paper. He says: "Thus in Group 1 of gall-bladder histories *recurring attacks of biliary colic* (italics are mine) characterize the story, with good health between. In Group 2 stomach symptoms play a prominent part but the *colic attacks* still form the diagnostic feature. In Group 3 the stomach symptoms preponderate, *colic* has disappeared and the gall-bladder symptoms have quieted down to minor importance."

Comment. These cases are all manifestly *late* cases in the sense of having already reached the formed calculus stage as demonstrated operatively in the finding of gall-stones in each of the illustrative cases Dr. Cheney has selected or they are *late* cases in the association of formed pathology, such as thickened gall-bladder or duct walls, inflammatory adhesions or involvement of the pancreas, duodenum and their lymph nodes. *These are the easy gall-bladder cases to diagnose and they are easy because we diagnose them too late to accomplish anything except by surgical measures at some risk to the patient and often too late to permit the surgeon to apply corrective surgery which will be permanent in its good results for the patient.*

Cheney further says, "In Group 4 there are no symptoms but those produced by the stomach, over months or years, and the gall-bladder speaks only vicariously, calling no attention directly to itself."

Comment. This is the important group to recognize in this stage of precalculus formation and prepathology. We must learn to diagnose this group if we desire to advance our present status of management of gall-bladder disease, and we can learn to do so by utilizing the intimate and direct diagnostic measures to be advocated, and not wait for the months or years to pass during which stones are forming and inflammatory adhesions are being developed. *Diagnosed at this stage many cures can be accomplished therapeutically by this method without having later recourse to surgery.*

Finally, Cheney says: "There should really be a Group 5 described where the gall-bladder contains stones but gives rise to no symptoms of any kind until either some sudden attack of pain or operation performed for some other ailment reveals cholelithiasis. But these cases sooner or later develop symptoms that put them into one of the four groups described, and they cannot be diagnosed until they do."

Comment. With this I would like to emphatically disagree. They often can be diagnosed, but not by the analysis of the history or the

physical examination, not by the forty-five minute test meal extraction nor by the roentgen-ray examination unless it is unequivocally positive. This group of so-called quiescent stones is necessarily also a late stage which has gone entirely unrecognized in its formative period, and I believe many cases of this group, as well as of Group 4, may in the future be included in the class of *preventive medicine* if more patients are routinely studied and treated by this method. Certainly all cases which give in their histories suggestive etiological factors such as typhoid fever, influenza, chronic bronchitis tonsillitis recurrens, chronic nasopharyngitis, sinusitis or oral sepsis should have such a study made. Also those patients require such a study who give a history of catarrhal jaundice and also, perhaps more particularly, those who have a progressive brownish pigmentation of the skin and who frequently show some jaundice of the sclera and of the hard palate or who may have the spider-web like tracings of capillary anastomoses of the collateral portal circulation just above the costal margin or who may have multiple telangiomas.

This group of cases is too frequently overlooked and the skin pigmentation will be frequently found due to chronic poisoning from static bile within the gall-bladder or within the smaller bile ducts around the liver lobules or due to poisoning from the waste products filtered out from the portal circulation by the liver and excreted in the bile; but poisonous products which are again reabsorbed into the portal system and carried back to a liver whose cells are becoming more and more fatigued by the endless load thrown upon them until they ultimately fail to secrete a bile normal in its chemistry.

Among this group will be found many cases of migraine, with or without biliousness, who have become victims of cholagogue laxative habits. Many cases of unsuspected duodenitis and of ileocolitis and sigmoiditis are among this group, as well as many cases whose appendices have been removed but who still continue to complain of gastro-intestinal dyspepsia of vague and nondescript types. Here, too, lie many cases of chronic visceroptosis with static bile from partial obstruction due to traction on supporting peritoneal attachments in the upper right quadrant.

I believe that many of these types of cases may be like those found in Cheney's fourth and fifth groups. Most of these cases *can* be diagnosed as having biliary-tract disease, but only by an intimate study of the chemistry, physical properties and the cytology and bacteriology of the gastro-duodeno-biliary fluids when analyzed with and balanced against the evidence of data obtained by history and physical and laboratory examinations. It is not so difficult but that it may be mastered by any clinician who maintains a properly functioning workshop.

I am sure that Dr. Cheney will understand that the above comments are not intended in any sense as derogatory to him. His writings enhance his reputation as an able clinician, as will be seen by a perusal of Chapter XXI, which he has contributed.

I feel, however, that the foregoing comments of mine on his earlier position in regard to gall-tract disease have been necessary in order to drive home the point of the great need of establishing earlier means of correctly diagnosing gall-tract disease, thereby giving us a better chance to throttle it in its infancy rather than in the old age of its life cycle. This I believe is made possible by the careful and painstaking application of the methods to be described in subsequent chapters.

CHAPTER VI.

THE BEGINNING OF A NEW ERA IN DIAGNOSIS AND TREATMENT OF GALL-TRACT DISEASE.

A DISCUSSION OF THE FUNDAMENTAL PRINCIPLES UPON WHICH THIS METHOD IS BASED AND A BRIEF OUTLINE OF THE METHOD.

IN presenting this chapter I have deemed it expedient to set down first my original conceptions of the fundamental principles underlying this method after I had studied and digested Meltzer's brilliant thesis and had proceeded far enough with my own studies into the practical application of Meltzer's suggestion as to permit me to formulate certain opinions of my own. This chapter then largely consists of a partial regrouping of statements and observations which I made in several of my earliest papers on this subject.(6)

In April, 1917, a paper was published by S. J. Meltzer (7) of the Rockefeller Institute which carried at the end this footnote:

"In experiments with magnesium sulphate I observed that the local application of a 25 per cent, solution of that salt on the mucosa (of the duodenum) causes a completely local relaxation of the intestinal wall. It does not exert such an effect when the salt is administered by the mouth, that is, when it has to pass through the stomach before it reaches the intestines. The duodenal tube, however, apparently has reached an efficient practical stage. I make, therefore, the suggestion to test in jaundice and biliary colic the local application of a 25 per cent solution of magnesium sulphate by means of the duodenal tube. It may relax the sphincter of the common duct and permit the ejection of bile, and perhaps, even permit the removal of a calculus of moderate size wedged in the duct in front of the papilla of Vater. Twenty-five cc of the solution as a dose for an adult will bring no harm. For babies the dose should not exceed 4 cc. The procedure could be developed into a practical useful method."

I believe that the experimental observations on animals, as conducted by Meltzer, have borne fruit and have opened up a way to a new method of diagnosing diseases of the gall-bladder and of the biliary ducts.

This very interesting observation of Meltzer's, although mentioned in an inconspicuous footnote, seemed to be pregnant with much practical importance, and served as an inspiration for a

clinical experimental study on human beings, at first with magnesium sulphate and later with other solutions. His paper was published in April, 1917, and that same month I began my first clinical experimental observations on human beings by means of the duodenal tube and various solutions of Epsom salts and other substances. During the past thirty-two months (to January, 1920) I have made over 1200 biliary taps on 121 different patients,* both for diagnosis and treatment, and I have become more and more convinced of the practical ease with which both the normal and the pathological biliary apparatus can be drained of its contents, with certain exceptions and within certain limitations, to which I shall refer later on. Further than this, I believe it possible to segregate and study bile obtained from the duodenum, from the bile ducts, from the gall-bladder and from the liver. I do not mean to infer that this segregation of bile can be made so sharply that it can be said positively that any given sample is derived *exclusively* from the bile ducts or from the gall-bladder or from the liver, but segregated to the extent that it is possible to infer that the *larger amount* of the various types of bile recovered during a biliary tap is being drained from the ducts, or from the gall-bladder or from the liver. If this much is admissible I believe it possible by cytological, cultural and chemical studies of these various portions of segregated bile to make certain *inferential* diagnostic deductions as to the condition of health—physiological or otherwise—or disease within those ducts, that gall-bladder or that liver.

In my first paper (6) I attempted briefly to classify the types of bile thus segregated from cases of cholelchitis, cholangitis, cholecystitis and cholelithiasis on the basis of their cytology, bacteriology, chemistry and their gross appearance. The interest with which that paper has been received in various parts of the world has encouraged me to present further observations of diagnosis and treatment by this method.

In presenting these observations I shall endeavor to record the phenomena which I have seen, to try to separate facts from theories and to hope to correctly interpret these facts and to substantiate these theories. Although I admit that personally I have arrived at certain very attractive conclusions from my studies I shall endeavor to refrain from stating them too positively, because I realize that conclusions, especially if premature, often take on the undesirable characteristics of the boomerang.

For a clearer understanding of what will follow in this chapter I

* Since the presentation of this paper in January, 1920, to January 1, 1923, the total number of cases studied by this method has reached 1104 with a total number of biliary drainages of 7593 of which careful records have been kept. This comprises the material upon which I have based the opinions expressed in this book.

shall again briefly epitomize the anatomy, the histology and the physiology of the biliary system, which has been discussed at some length in earlier chapters. I can describe the anatomy of the biliary system in a somewhat primer-book fashion as follows: The liver, the largest of the digestive glands of the body, is an organ whose substance is made up of myriads of bile-secreting polyhedral cells and certain stellate cells (Kupffer) arranged in the form of a lobule. Each lobule is supplied with blood coming from the portal vein and from the hepatic artery. In the portal vein the blood carries soluble substances absorbed from the intestines, certain of them useful substances, such as the various glucoses and proteids, which are reabsorbed from the portal blood by the liver for further use, and certain waste products drained from the organs emptying into the portal vein and which the liver must excrete. The hepatic artery brings to the liver cells themselves their daily pabulum, which permits them to carry on their function of absorption and secretion. Each lobule, too, is furnished with a rather complicated network of vascular and bile capillaries, but for my purpose it is enough to recall the fact that the bile capillaries run in minute grooves or canals between the trabecular-like tubules of liver cells, which they drain and then empty the bile into the interlobular bile ducts. These interlobular ducts empty into larger channels, which in turn carry the bile into the right and left hepatic ducts and thence out of the liver. The lymphatics and nerves to the liver follow somewhat the same general arrangement.

The liver, therefore, has four principal functions: absorption, secretion, excretion and neutralization of toxins. It *absorbs* from the portal blood soluble products from the intestinal tract—notably sugar, proteid and bile salts—which are acted upon by the metabolism of the liver cells before being stored up in the liver or passed back again into the general (blood or bile) circulation. It *secretes* a fluid substance called bile, which is of great aid to proper digestion, particularly acting as a co-partner with the pancreas in the splitting and digestion of fats. By means of the bile it *excretes* waste products and bacteria brought to it by the portal blood and probably by means of metabolic activity of the liver cells *filters out, or neutralizes*, toxins, both chemical and bacterial.

The bile is carried from the liver by the right and left hepatic ducts, which soon unite into a larger one, and are joined by the cystic duct, and their union forms a larger (or common bile) duct, which empties the bile into the very beginning of the intestinal tract. These efferent bile ducts are lined by columnar epithelium varying in height according to the caliber of the duct. The larger ducts are supplied with unstriped muscle fibers, chiefly longitudinal, and small mucous glands. At the terminal portion of the common

bile duct, in that portion that runs obliquely between the coats of the duodenum, this unstriped muscle becomes augmented into a definite circular bundle, which Oddi (8) described, and which acts as a sphincter controlling the expulsion of bile into the intestine. Connecting with the cystic duct is a pear-shaped, distensible sac, the gall-bladder, which is composed of an outer coat of fibrous elastic tissue, a muscular coat, largely composed of circular bundles of unstriped muscle fibers, and a mucous coat covered with a single layer of columnar epithelium and thrown up into a network of slightly raised ridges that give the mucosa a reticulated appearance. At the neck of the gall-bladder may be found branched mucous glands.

That the gall-bladder has a function has recently been disputed, especially by surgeons, but if it has a function—and I, for one, believe it has—it primarily consists of acting as a reservoir for the bile secreted by the liver, which dripping down the bile ducts encounters a closed sphincter, and which has no outlet except to dam back through the cystic duct and into the gall-bladder. Here it remains stored for a variable time, becoming more concentrated,* until physiologically the sphincter of the common duct is relaxed, as a spurt of gastric chyme enters the duodenum; then bile is poured into the intestine in quantities suitable to the needs of the elements in the food to be digested, and here is where the secondary role of the gall-bladder function comes into effect. It is a well-known fact that a gastric chyme rich in fats, proteoses and peptones, partly because the bile aids in their direct digestion and partly for other reasons, as it passes the duodenal mucosa stimulates an excessive amount of excretion of bile. This then the healthy gall-bladder is able to furnish in concentrated form and appropriate dosage, whereas a diet rich in carbohydrate in whose digestion the action of bile is less concerned does not cause as copious ejaculation of concentrated bile; but the carbohydrates need pancreatic juice, which is delivered through the relaxed common duct sphincter together with such quantities of bile as may lie in the ducts. For the digestion of this type of diet it is altogether likely that the gall-bladder does not play such a prominent part.

Prolonged periods of quiescence on the part of the gall-bladder—waiting for its physiological stimulus of fats or end-protein-products of gastric digestion—should logically predispose to biliary stasis.

It would be interesting to ascertain the relative frequency of functional (?) biliary stasis and later biliary disease occurring in people who have adopted a vegetarian dietary. This would help to settle the question. Similarly, it would be interesting to learn

* Cf. Experimental Work of Rous and McMaster. See pages 131 and 133.

the liability of biliary stasis and gall-bladder disease occurring in men (or women) who for some years have worked under pressure, and have either missed the noonday meal or have hastily eaten a piece of pie or shredded wheat biscuit and glass of milk—a characteristic lunch of the busy business man or doctor during his foolish formative years. I can think of several such doctors who are today minus their gall-bladders.

Now let me pick up some of the loose ends and partly recapitulate. We see that physiologically the biliary system consists of an organ (the liver) which is probably constantly secreting bile at varying rates, but is excreting it intermittently into the intestines. The function of excretion is controlled by the physiological opening and closing of the sphincter which guards the outlet of the bile-conducting tubes. It has been found that the strength of this sphincter will sustain a force variously estimated as equivalent to a column of water from 200 to 600 mm. in height. (See page 137.) When this sphincter is closed it is probable that the secretion of the liver slows down somewhat, but it is also most probable it does not cease altogether and that the bile secreted passes down the ducts to find the sphincter closed, and having no other outlet the excess bile dams back into the gall-bladder—which has wisely been placed in the proper position to act as a reservoir for such an overflow. Is it not probable that the gall-bladder has been provided with an outer fibro-elastic coat to permit of variable degrees of distensibility? It is true that the velocity or rate of liver secretion varies in response to substances brought to it in the blood (and possibly through nervous influences), for Bayliss and Starling (1) have demonstrated that an acid gastric chyme on reaching the duodenum activates prosecretin into secretin, which is carried to the liver by the blood and stimulates its secretory activity, in a similar way in which these same hormones influence pancreatic secretion. It is my opinion that there may be a hormonal influence that passes to the gall-bladder itself which, *independently* perhaps of that inducing increased velocity of liver secretion, causes the gall-bladder to express various amounts of its concentrated bile, and that this selective hormonal influence may lie in the *food chemistry* (proteoses and peptones) of the acid gastric chyme. For I, as doubtless many other observers, have been impressed with the inferential diagnostic importance, in patients with the biliary syndrome, of the low subacid or anacid fractional gastric curve, as pointing to biliary stasis with cholelithiasis rather than to cholecystitis alone. In my experience the cases of cholecystitis are more liable to show a normal or hyperacid fractional curve not unlike that seen in the majority groupings of duodenal ulcer and chronic appendicitis with reflex gastric symptomatology.

Now upon what does the mechanism of emptying, partially or wholly, this biliary system depend? We can look for the answer to this by examining into the nerve supply of the duct sphincter and of the gall-bladder.

Doyen (4) has specially studied the innervation of the gall-bladder, and his experiments were confirmed and amplified later by Freese. (5) Both have shown that the gall-bladder receives both motor and inhibitory fibers by way of the splanchnic nerves, which emerge from the spinal cord in the roots of the sixth thoracic to the first lumbar and pass to the celiac plexus.

Sensory fibers capable of causing a reflex constriction or dilatation of the gall-bladder are found in both the vagus and the splanchnic nerves, and it is found that stimulation (a) of the central end of the cut splanchnic causes a dilatation of the gall-bladder (reflex stimulation of inhibitory fibers); but that stimulation (b) of the central end of vagus causes a contraction of the gall-bladder, and a dilatation (inhibition) of the duct sphincter. It is probable that the afferent fibers run in the vagus.

Conversely, stimulation of the peripheral end of the splanchnic nerves in the duodenum and the common bile duct causes simultaneously a relaxation of the tonus of the duct sphincter and a contraction of the gall-bladder.*

Thus we find a double innervation of antagonistic or crossed action, which Meltzer calls "contrary innervation," and around which he has formulated a "law of contrary innervation," which he not only applies to emptying the gall-bladder but which he finds holds true for many functions of the animal body.

Meltzer draws an analogy between the biliary and the renal system. The latter is made up of a constantly secreting organ, the kidney, passing its secretion down a series of tubes guarded at their outlet by a sphincter muscle with a distensible sac, the urinary bladder, placed between the two. Owing to the double and contrary innervation of this system, when we wish to empty the bladder we contract the detrusor muscle of the bladder and inhibit the tone of the sphincter urinæ, and when the urine has been expelled the process is reversed, the sphincter contracts and the detrusor muscle becomes relaxed until sufficient kidney secretion has accumulated to fill or partially fill the bladder again when the act is repeated. This, of course, in health is a voluntary action, whereas the emptying of the biliary system is entirely independent of the will—otherwise the analogy is complete. Would that we were given a

* See contrary findings of Bainbridge and Dale (Jour. Physiol., 1907, **33**, 138), quoted by Crohn (see discussion of Crohn's criticism, page 138). Therefore, as Meltzer states, the exact innervation of the concerned parts is not yet settled as to details.

consciousness of an overdistended but otherwise healthy gall-bladder and could empty it when we wished, for then many of the diseased states of the gall-bladder, which we are now called upon to diagnose and to treat would be forestalled. But Nature has left the solution of this secret for our present and future endeavors. Possibly we are nearer the threshold of discovery than we think.

Now to make my hypothesis more understandable let me quote from Meltzer's article at some length. He says:

"While the physiological muscular and nervous mechanism of bile storage and bile discharge is thus satisfactorily explained, the question presents itself: What are the causes that bring about either of the two actions? We compared the mechanism of the gall-bladder with that of the urinary bladder. But the latter is to a large degree under the management of the will, and the sensation of fulness and other sensory stimuli bring the condition of the bladder to the attention of our consciousness, which, by means of the will, sets the required part of the mechanism into action. The processes of storing of the bile or of emptying it never comes to our consciousness and are never managed by our will. What does then manage their proper activity? We must admit that we do not yet know a great deal about it. It is probable that certain conditions and certain substances exert a selective action upon the reciprocal reflexes. It is interesting to quote here some newer instructive statements. One comes from Pavlov's school. Bruno (2) stated that no bile appeared in the duodenum as long as the stomach is empty—when a meal is taken the entrance of chyme into the duodenum gives the signal for an ejection of bile from the common duct. Most interesting are the recent studies of Rost (9). He first established the fact that after *cholecystotomy* the escape of bile through the papilla of Vater is indeed continuous, while in normal animals it is a discontinuous one, depending upon the entrance of food into the duodenum. He found, further, the instructive fact that injection of peptone or albumoses through a duodenal fistula in a normal dog causes immediately a discharge of bile from the common duct, and he has proved that this takes place by a reflex act which causes a contraction of the gall-bladder and simultaneously a relaxation of the sphincter of the common duct.

"From the foregoing it seems quite safely established that the physiological discontinuous character of the flow of bile into the duodenum is regulated by a reflex mechanism, dominated by the law of contrary innervation; that the integrity of the gall-bladder is an important part in this reflex mechanism; that the discharge of bile can be greatly curtailed by the absence or a restriction of the discharge of chyme from the stomach into the duodenum and that the discharge of bile through the papilla of Vater into the duodenum

is greatly enhanced by the presence in the lumen of the latter of peptone or albumosis."

It is probably beyond controversy to say that the physiological mechanism of the storage and discharge of bile is a reflex mechanism. It remains for the future to decide how much of it is a direct reflex (gastric chymes, etc.) and how much indirect, due to hormonal action. It is certain that both of these factors, and possibly others, enter into the complete physiological mechanism.

Now, then, the hypothesis upon which I have been working frames itself around the fact that Meltzer (reinforced by the observations of Rost) found that by douching the duodenum *locally* with magnesium sulphate he could relax the duodenal wall and probably with it the sphincter of the common bile duct. This was all he said, but arguing from cause to effect it seemed evident that if his law of contrary innervation were a sound one, when the sphincter was inhibited the gall-bladder should be stimulated to contract and should empty its contents (wholly or in part) into the duodenum, and by means of the duodenal tube the bile could be collected into bottles for study. This was by no means difficult to verify, and after a few observations the practical possibilities of this very simple method of examining into the diagnosis of many of the biliary diseases was quickly seen. And later, as I have gone on with my observations, there has dawned on me a very attractive vista of future possibilities, particularly in regard to treatment by this method if only I can bring it to the attention of the profession in general, and if I can stimulate others to study into its practicability.

And now I have come to a point where, with this preliminary understanding of the question I am discussing, and without coming to definite or hasty conclusions myself, I will ask you to examine carefully the sequence of findings in a non-surgical gall-bladder tap and by your critical discussion of them help to put a correct interpretation upon their meaning.

When a duodenal tube is passed through the pylorus of the stomach, during its interdigesting or fasting period, it should find in *states of health* the sphincter of the bile duct closed and the duodenum free of bile; but within a few minutes after irrigating the duodenal mucosa with a solution of magnesium sulphate of various strengths it will be possible by either gravity drainage or by gentle vacuum suction to recover bile, indicating that the tone of the sphincter of the common duct has been inhibited, its walls relaxed and that by the *vis a tergo* in the biliary apparatus the bile is being forced into the duodenum.

There should be little argument over the statement of my belief that in the event of finding the sphincter closed, that the first bile collectible should be coming from that lying within the ducts

themselves, and especially of the common duct, since it is obviously the first source of supply. To relax the common duct I began by using a solution of magnesium sulphate varying from 12.5 to 50 volumetric per cent of a saturated solution in amounts between 50 to 100 cc. It has seemed to me that the stronger solutions of 25 to 37.5 per cent have given an optimum amount of sphincter relaxation which lasts from a period of one to two hours.* Through the glass window cannula placed about eight inches from the proximal end of the tube can be observed the changes in color, viscosity and grossly abnormal elements in the bile being recovered and which can be received into separate receptacles for differential study by attaching sterile bottles.

The first bile collected is usually diluted with a few cubic centimeters of the magnesium sulphate solution, but its color gradually deepens until it becomes apparently a pure bile of a light golden-yellow color and of medium viscosity, like that of syrup, and in healthy bile ducts perfectly transparent (with a certain exception to be mentioned later, see page 115). After a few cubic centimeters of this bile have been withdrawn (which varies, perhaps, from 10 to 30 cc.) the bile suddenly deepens to a considerably darker golden-yellow and becomes noticeably more viscid, and usually transparent in healthy states, draining sometimes steadily, sometimes with slight intermittency until amounts have been recovered, which, within my personal observations, have varied from 10 to 300 or more cc. in pathological cases (10 to 75 cc. in normal cases), when a sudden transition in color and viscosity of the bile again appears, this time to a light transparent lemon-yellow and a distinctly thinner and more limpid bile than either of the former types, and this type of bile continues to flow with considerably greater intermittency as long as the relaxation of the common duct sphincter is maintained; the amount of this last type of bile recovered has varied from a few cubic centimeters to several ounces.

Now I will ask the question, Where is this darker colored bile in the amounts of from one to ten ounces coming from? It is my personal belief that it is coming from the gall-bladder *wholly or in part*, but *mixed*, probably, with a few cubic centimeters of bile still delivered from the ducts or bile freshly secreted from the liver. This is really one of the central points of this hypothesis. Is this darker colored bile coming from the gall-bladder?

My reasons for believing it is derived in large part from the gall-bladder itself are four:

1. Because I believe that Meltzer's law of contrary innervation

* I now routinely use a 33 (volumetric) per cent solution of magnesium sulphate which is equivalent to a 16.6 per cent of the magnesium salt itself, where the solution is made up in distilled water at 25° C.

as applied to the biliary apparatus is a fundamentally correct one and is based upon a sensible interpretation of the most probable mechanism of the physiological storage and discharge of bile, supported by the experimental observations already recited, and which I have had opportunity to confirm by my clinical experimental studies. Now, if this law of contrary innervation as applied to the biliary system is a tenable one, and if the action of magnesium sulphate serves to relax the tonus of the sphincter of the duct, then it

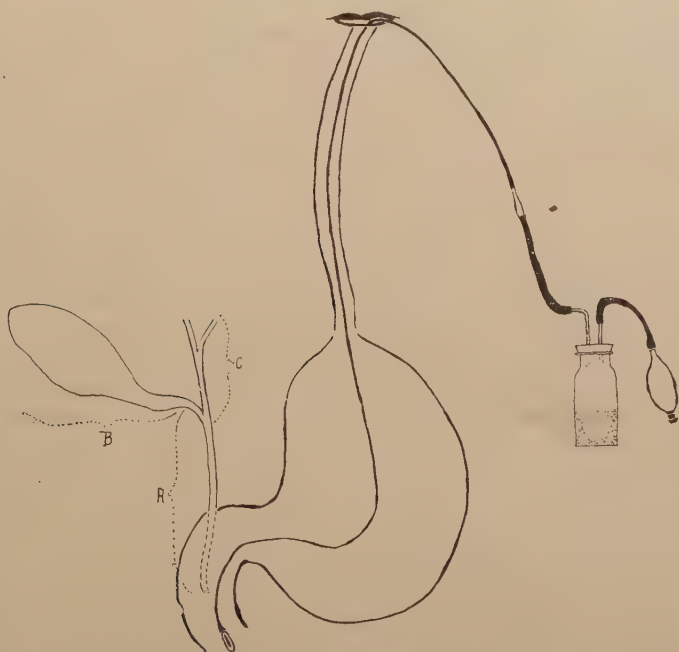


FIG. 51.—This drawing illustrates the method of non-surgical biliary drainage part of the apparatus used and the sources from which the various types of bile are obtained. A set of three or more sterile bottles is used for each segregation of bile for diagnosis.

should also serve to stimulate (contract?) the gall-bladder and cause it to expel its contents, *wholly or in part*, depending on the one hand on the tonicity possessed by any given gall-bladder wall and upon whether its cystic duct is patulous, and on the other hand upon the length of time in which the impulse to gall-bladder contraction and sphincter relaxation continues to be maintained.

2. My second reason lies in the fact that the color and viscosity of this second bile indicates a higher concentration and strongly suggests it as coming from its storage chamber within the gall-

bladder;* that in certain pathological cases (cholecystitis and high grade biliary stasis) this bile is a thick, sometimes almost tarry, greenish-black, of the consistency that we have seen scooped out of the operated gall-bladder; that its cytology in health, but far oftener in diseased states, shows a larger amount of desquamated tall columnar epithelial cells deeply bile-stained, as if they had lain in contact with concentrated bile for some time. On occasions I have recovered bile-stained columnar epithelium in such massed abundance that they gave a ridged appearance, such as the reticulated folds of the gall-bladder mucosa possesses. Furthermore, in cases of clinically suspected cholecystitis it is in this second bile that appear by far the larger number of mucopurulent flakes, rich in pus cells and inflammatory débris and often swarming with bacteria, and lastly because the microscopy of this second bile discloses usually the larger deposition of bile crystals. In several calculi cases that have been operatively (or otherwise) confirmed, bile crystals occurred in such abundance as to give a gritty or sandy feel to the bile when rubbed with the finger. This observation, together with one other that I shall mention later (see page 115) offers the most practical differential inference as to the presence of potential or present cholelithiasis.

3. My third reason for believing that this second bile is derived largely from the gall-bladder lies in the fact that unless we account for it as gall-bladder bile we must account for the presence of from one to (in certain cases) ten ounces of this darker colored and more concentrated bile as coming from somewhere between the common duct sphincter and the secreting cells of the liver. Now, how much bile do you suppose the common and hepatic ducts can contain in their total length of $8\frac{1}{4}$ inches and their average diameter of $\frac{1}{4}$ inch? Surely it is unlikely that they could hold 90 to 300 cc. At any rate, if this second bile is *not* from the gall-bladder the burden of proof will rest with the opponents to my theory as to whence it is derived.

4. My fourth reason, and I feel it is the strongest, for believing that this second type of darker yellow and more viscid bile is actually coming in large part from the gall-bladder lies in this (I think) convincing fact, namely, that in the cholecystectomized patients that I have studied postoperatively, some ten† or more cases, I find, (a) that I never recover the second type of dark bile,‡ but pass immediately from the light golden-yellow or relatively more

* Later Experimentally Confirmed by the Work of Rous and McMaster. See pages 131 and 133.

† Now over seventy cases.

‡ It is conceivable that in cases in which the gall-bladder has been removed, and in which the ducts remain infected and the common duct becomes secondarily obstructed, that in such cases dark, inspissated or static bile might be recoverable.

concentrated common duct bile to the light lemon-yellow and limpid bile that I believe is freshly secreted liver bile and collectable for long periods as rapidly as it is secreted, and (b) I find that (in this cholecystectomized group) in the larger number of instances bile is continuously entering the duodenum in the fasting stomach and duodenal state, except in secondary cholangitis with obstructive jaundice, indicating that the duct sphincter is in a state of inhibited tonus, probably permanently so, since the antagonistic or contrary innervation has been cut when the gall-bladder was removed.

5. I might add a fifth reason, to the effect that in my post-operative group of cholecystostomized patients upon whom this non-surgical method has been practised (because the length of time over which surgical drainage could be maintained has not been sufficient to allay the catarrhal inflammation or to arrest the infection), that is in this group, together with a group of non-operated patients with cholecystitis or with gall-bladder biliary stasis, I have seen this second type bile, easily demonstrable as pathological, gradually clear up and return to a more normal appearance under biweekly drainage by this method.

A little while ago, I made the statement that within my observations I find the bile, always in states of health, and indeed in certain states of disease (*e. g.*, infective cholecystitis of low grade without producing a recognizable catarrhal inflammation, and in certain types of biliary stasis) of a transparently clear yellow color with one exception. This exception occurs when a spurt of acid gastric juice enters the duodenum and mixes with the bile being collected, when an instantaneous emulsive turbidity is produced. This was confusing at first and is still annoying. Dr. Bartle, working with me, found that this turbidity could be produced in the case of every clear bile by artificially adding dilute hydrochloric acid. The density of this turbidity varies apparently in direct proportion to the concentration of gastric acidity on the one hand and on the other according to various alterations in the chemical constituents of the bile. The microscopy of this type of turbid bile reveals a precipitate (?) of neutral fats, lecithin, mucin and occasionally other elements, which as yet I have not identified.

I wish, too, at this point to state the second observation that may help in the differential diagnosis of cholelithiasis by direct study of the bile (in addition to the gritty feel of some biles due to excessive crystalline precipitation), and it is this that occasionally when a spurt of gastric acid juice reached the duodenum, besides causing the aforesaid turbidity it creates an *effervescence* that is quite noticeable and continues for some time. It resembles closely the reaction seen in the urine containing carbonates on adding acetic acid, and suggests the possibility of detecting in the bile a carbonate

(or phosphate) diathesis which may be concerned in calculi formation of the calcium variety. This point I believe will bear watching in the future. I have not encountered this turbidity of bile in cases in which there is gastric anacidity or achylia, nor so frequently, or with such a dense turbidity in those cases having gastric subacidity, and since it is in just this group of gastric curves that the chief diagnostic relationship to cholelithiasis lies, I would make the suggestion that in all cases the bile being studied should be artificially acidulated with hydrochloric acid and the resultant turbidity microscopically and chemically investigated.

I hope by now I have made clear the reason why I believe the general hypothesis upon which I have been working is sustainable and that you will now more fully appreciate the reasonableness of my arriving at certain conclusions in regard to whose tenability I solicit your critical weighing of the evidence I have put before you. It sums up into this, and brings me back to one of the early paragraphs of this chapter, namely, that by this method of direct (hormonic?) stimulation of the contrary innervation of the gall-bladder and the duct sphincter I believe it is possible to drain the biliary system, to actually empty the gall-bladder, *partially* or *wholly* of its *fluid* contents, and to segregate the several biles recovered (somewhat roughly I admit) in such a manner as to make it practically possible to make certain differential diagnostic inferences as to the state of health or disease of the several components of the biliary system in a scientifically correct manner not hitherto attainable. (See Chapter XVIII.)

Now if I have presented my argument sufficiently clearly, and if it can be temporarily admitted, and perhaps definitely proved in the future (and I shall have some suggestions to offer later as to how this direct proof can be obtained*) that it is possible not only to drain the bile ducts and the liver of its secreting bile, but also the gall-bladder itself, then I need not now do more than to direct attention to the possibilities that this method opens up for the treatment of various biliary states that heretofore have been best attained by purely surgical methods and to stimulate enthusiasm for investigating into the precursory and probably functional states of biliary disorders of motor, secretory, and nervous origin which, if allowed to continue, will almost invariably lead to inflammatory, infective or calculus-forming states of disease.

In my opinion the most hopeful feature of this method lies in its practicability of investigating, by clinical experimental observa-

* The suggestion, here referred to, was to intubate the duodenum of a patient about to be operated upon, but before being anesthetized, and after the abdomen was opened to introduce the solution of magnesium sulphate and observe its effect on the gall-bladder. These experiments are referred to in the following chapter.

tions, in the attempt to detect some of the physiological alterations of *function* of the gall-bladder, liver and ducts; disorders of function, such as the hitherto undescribed entity of functional *atony* of the gall-bladder; spasm of the ducts and lowered velocity rates of liver secretion, which directly contribute to slowing up the excretion of bile and bring about biliary stasis.

For it is biliary stasis that all writers are in agreement as being the forerunner of gall-stones and of inflamed and infected gall-bladders and gall-ducts. Any successful method of directly determining biliary stasis immediately opens up fields of investigating and explaining such common conditions as we loosely call biliousness, liver lethargy, hepatic torpor, with their resultant migraine and migrainoid attacks with biliary vomiting.

If we are to attack the great problem of gall-bladder disease, gall-stones and gall-bladder and duct catarrhs and infections, and attack it at its source, we must give this lightly passed over symptom-grouping called "biliousness" our serious attention. Thus far our attitude toward the gall-bladder problem has been one of *correction* of the full-blown stages of formed calculi and active catarrhal infection, and the means adopted have been largely surgical. The surgeon's achievements in pioneering this subject have been very great. Their results have been at times brilliant, often less satisfactory and not infrequently bad, requiring many and repeated surgical maneuvers usually eventuating in that *bête noire* of surgery, distorting postoperative or postinflammatory adhesions, so that the state of chronic invalidism of the patient is a heavy cross to bear. What we must do is to attack the problem with methods of *prevention* of gall-bladder disease, with its sequelæ, and this brings us back to attacking the biliary stasis which is at the root of the matter. Biliary stasis is followed by overdistention of gall-bladder and ducts, leading perhaps to what we may designate in the future as gall-bladder atony. This engenders catarrhal states of gall-bladder and duct mucosa, weakening resistance, and permits of successful implantation of infecting microorganisms, filtered out from the portal blood or carried directly to the gall-bladder by the systemic blood or by the lymphatics, or ascending to the gall-bladder by way of the duodenum and the common duct or passing through the serosa of the gall-bladder from direct contact with contaminated peritoneal coverings of neighborhood viscera. Biliary stasis, with its concentrated bile and precipitation of its crystalline chemistry, plus catarrh, plus infection, means gall-stones. Therefore it is biliary *stasis* that we must attack if we are to prevent gall-stones, catarrhs or infections.

Can we do so? I think we may entertain greater hopes of so

doing if wide application can be made of this method of investigating into some of the predisposing factors and conditions that we know enter into the precalculus and preinfective states of the gall-bladder and ducts. I would suggest that the problem be attacked first by a careful clinical study of that large group of individuals who have periodic or cyclic attacks of so-called "biliousness," or "lazy" liver, ushered in by gradual loss of ambition, increasing sense of mental and physical heaviness or lethargy, constipation, furring of tongue, metallic sense of taste, loss of appetite and headaches and eye-aches of greater or less severity; many attacks terminating in the true migraine type, accompanied by nausea and vomiting, various ocular manifestations, dizziness and various degrees of prostration, a group of symptoms that in some degree we meet within our practice nearly every day. These patients usually find out for themselves that their complaint is best relieved by calomel or other of the so-called cholagogic group of medicines, and they learn, furthermore, that they are rarely cured by such means. Various pharmaceutical houses, to say nothing of many independent pseudo-doctors, have made fortunes, as well as paid for a lot of expensive advertising and literary propaganda, from exploiting this very common symptom-complex, advising this or that laxative pill or liquid medicine, which at best gives only a modicum of temporary relief.

I surmise that it will surprise many of you to recover from such patients four ounces or more of static bile from a gall-bladder whose normal capacity all anatomists agree in limiting from $1\frac{1}{2}$ to $2\frac{1}{2}$ ounces. When such amounts are recoverable I think it reasonable to assume that such a gall-bladder is being stretched beyond its physiological limits of distensibility, and if this stretching is continued such a gall-bladder loses its normal tonicity of contraction and the organ becomes functionally atonic (as does any other hollow and distensible viscus, such as the stomach, the colon, the bladder, etc.) and is physiologically incapable of emptying its contents completely. In the future we may be able to speak of such gall-bladders in terms of "residual bile," as we now are quite accustomed to the term of residual urine in the domain of the urologists. I hazard the prediction that in the future the duodenal tube may be used quite as easily and freely, and certainly far more painlessly, to empty such distended gall-bladders as the urinary catheter is used today. And no thinking doctor of today would dare challenge the statement that such functional (?) disorders of the gall-bladder have a most important bearing on the production of later and more serious gall-bladder diseases.

I see no great difficulties in studying by this direct means the clinical-pharmaceutical action of the whole series of so-called chola-

gogues by both directly douching the duodenum with these drugs in solution and by allowing them to be swallowed and passed through (or absorbed by) the stomach and note the rate and amount and type of biliary discharge. The same method of study can be paralleled in investigating the recent pharmaceutical preparations designated as hormones to stimulate pancreatic secretion and the recovered mixed bile and pancreatic juice can be studied for pancreatic efficiency. Similarly the group of antispasmodics, atropin, belladonna, benzyl-benzoate can be investigated, as well as the effect of Witte's peptone or of egg albumen subjected to preliminary artificial gastric digestion, and of various meat extracts and extractions.

There are unbounded avenues of investigation waiting to be taken up, all of which will have a direct or indirect bearing on solving the great problem of gall-bladder disease, namely, the prevention of biliary stasis and thereby that of cholelithiasis.

One very practical field of usefulness came to my attention during my summer service in 1919. Several fully convalescent typhoid patients were retained in the hospital because their cultures from either urine or stool still came back "positive for typhoid bacilli," and they could, therefore, not be discharged on account of the danger of becoming "carriers." Several such patients were found to be harboring typhoid bacilli in their static gall-bladder bile. This is the time to treat such a case by non-surgical drainage, and that patient may not need to be operated upon several years, or even decades later for the removal of gall-stones from whose nuclei the pathologist may report the bacteriological recovery of a pure culture of the *Bacillus typhosus*, as has happened quite frequently in the past. I would suggest considering the advisability of testing directly the biliary excretions of all convalescent typhoid patients, both to prevent their becoming "carriers" and to guard them from later developing more serious gall-bladder disease.

One good reaction, as the pendulum swings from one extreme to the other, I am sure many of us have welcomed as being a rational one, and that is to stop starving our typhoid cases as we used to do ten to fifteen years ago and to start feeding them on a sensible dietetic plan as advocated several years ago by Coleman. Since this plan of feeding has been more widely carried out we have seen fewer instances of a complicating typhoid cholecystitis, for the simple reason that we are now giving the patient food mixtures that stimulate the production of an acid chyme capable of changing proteids into proteoses and peptones and thus deliver to the duodenum a food hormone that permits the duct sphincter to relax and the gall-bladder to express its static bile. I think this point is worth considering also in connection with the dietetic management,

assisted by artificial gastric juice, in those subacute and chronic infections of long standing that tend to create a state of gastric subacidity.

For similar reasons in treating a selected medical group of duodenal ulcer cases (the non-obstructive type, etc.) by duodenal feeding I am draining their gall-bladder once a week to prevent the bile from becoming static during that three or four weeks' period in which the duodenum is deprived of the food-bearing acid gastric chyme which acts as one of the physiological reflex agencies for bile discharge.

This is a good place to refer to the natural limitations of this method and to the fortunately small group of diseased states of the gall-bladder and ducts in which it is probably impossible to empty the gall-bladder. I refer especially to those cases in which the cystic duct is obstructed,* although this may prove to depend somewhat on the nature of the obstruction and upon the relative tonicity remaining to the gall-bladder. I do not believe it will be possible to empty the gall-bladder when a calculus is embedded in the swollen and congested lumen of the cystic duct, although Nature has, in times past, accomplished this even when unassisted. It will be impossible, naturally, to empty the gall-bladder when this duct is mechanically obstructed by inflammatory adhesions or when an enlarged lymphatic gland alongside of the cysticus obstructs it by direct mechanical pressure, as Deaver (3) called our attention to some years ago. Nor do states of hydrops, due to swelling of the mucous glands at the neck of the gall-bladder, offer much better chance of success, and certainly not when a mass of calculi make a stony cast filling the entire lumen of the gall-bladder sac.

The practical value of this method, so far as it concerns treatment, is that it adds greatly to our medical armamentarium in treating all of the recognizable early states of biliary stasis, many of the later states of biliary stasis as seen in patients with atrophic gastritis (often preceded by oral sepsis), with pernicious anemia, with certain forms of auto-intoxication and that large group presenting symptoms of both early and late migraine states. I have elsewhere (6) reported my results in treating simple catarrhal jaundice in which I was able to reduce the duration of the disease by 52 per cent in one group of patients as compared to a second group treated by the customary symptomatic or expectant plan, and I have learned, through personal communications, that other doctors have since had even greater success with the method.

I believe that by this method we can adopt in a non-surgical way the generally accepted surgical principles of free drainage as applied

* See discussion of cystic duct obstructions on page 331.

to some of the early catarrhal and infective conditions of the biliary tract, and I believe, do it thoroughly and effectively, with a far better check on how effective it really is and with an avoidance of certain definite surgical risks. It cannot and need not supersede surgery—the very necessary surgery—for the removal of calculi, for the drainage of acute or chronic empyema, for the removal of the gall-bladder in gangrenous cholecystitis or when its wall or lymphatic glands are the seat of a chronic focus of infection, or of carcinoma, or for the relief of mechanical obstructions produced by adhesions, although it might be well used to *supplement* some of these operations and to further the ultimate recovery of the patient. The physiological mechanics of this method should appeal to the surgeon, and therefore what I have said in this chapter need not offend the minds of those who think only from the surgical-mechanical angle that nothing is good or worth while doing unless it is done by means of the aseptic scalpel, and who continue to teach suffering humanity that the only royal road to health is by the “cut well, sew well, get well” route.

I am not so sure that by the dead pathology of the autopsy room or by the living pathology as seen at the operating table we have obtained the complete picture of many diseases; we have caught the full-face view, but I feel convinced that we have missed many of the profiles, to say nothing of the full-length multiple-mirrored reflection.

During the past two or three decades we have learned much of the later life history of disease. The development and extensive use of the microscope applied to examining in closer detail our autopsy material has taught us many facts of dead pathology. The wonderful accomplishments of surgeons during this time by their marvelous dissection and removal of diseased tissues have taught us much of the living pathology of those earlier stages, that if uncorrected speed on the lethal end. It is true that we have been taught the characteristic lesions that diseases, if left unchecked, can by their very nature produce; but let us take a bird's-eye view of what has been accomplished in the past decade by that relatively small but brave band of physiologists who have come on with the giant stride of the seven league boots, and I opine that the wise doctor of the future will be he who with open mind can grasp the accepted facts of experimental physiology and by practical use of physiological principles assist Nature to help herself. Not that we have not done much to correct by our increased knowledge and skill pathological lesions, but that we should do still more to prevent them.

I confess, too, to have lost my enthusiasm for and my belief in the infallible diagnostic acumen of the intuitive genius who by

simple touch of the "educated" finger can say that this patient has a chronic cholecystitis and that one a chronic appendicitis, and thereupon proceeds to remove the perhaps unoffending organ on the ground that its physiological function is aborted or that it harbors a pathogenetic factor that menaces future health and still leaves residual infection, the postoperative adhesion or the incisional hernia. My dispensary clinic is only too full of the results of such faulty diagnosis and injudicious surgery.

And I find it difficult to believe that the trained master of living pathology can always tell by practised eye and touch that this gall-bladder, with its somewhat thickened and shrunken wall, is physiologically incompetent and incapable of resuming its function and make a bull's eye every time. A critical review of Case No. II will serve to support this contention.

You will see, then, that I am presenting this method of physiologically draining the gall-tract (1) as a *means of diagnosis* of biliary diseases to supplement the usual clinical methods of diagnosis and the great help given us in many cases by the roentgenologist; (2) as an *alternative method of treatment* of many types of gall-bladder and duct disease in which there arises a question of opinion as to whether surgery is or is not emphatically and immediately indicated, and (3) as a *supplementary method* of postoperatively continuing the surgical principles of drainage in those cases incompletely cured by surgical measures alone.

To present the merits of this method of diagnosis and treatment it is clearly necessary that I submit for inspection a few case reports of patients so treated. These case reports (which will be found in Chapter XXVII to XXXVI) have been selected for the purpose of illustrating different points contained in the subject-matter of this and other chapters.

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CHAPTER VII.

AN ANSWER TO ANTAGONISTIC CRITICISM ATTACKING FUNDAMENTAL PRINCIPLES OF THE METHOD.

SINCE this method of non-surgically attacking gall-tract problems diagnostically and therapeutically was formally presented in September, 1919, I have published a series of papers (28) outlining the principles upon which this method is based; carrying the subject through the technic which I urge should be adhered to for safeguarding more accurate differential diagnosis; emphasizing again and again the need of earlier diagnosis of gall-tract disease (which can be obtained by this method) if we are to make headway in its treatment; calling attention to the possibilities of taking further steps in the prevention of gall-stones, and late gall-tract pathology; and, finally, giving a classification and citation of cases which represent the group of gall-bladder and gall-duct and liver disease in which it has a proper field of practical therapeutics.

At first the field of treatment by this method was approached with a properly cautious conservatism until our experience grew and our records had developed some really brilliant recoveries. Now much more can appropriately be said. Following the introduction of any new method which tends to revolutionize certain of our firmly established conceptions, and particularly a method so pregnant with future possibilities as is this one, it is not unnatural that it should have awakened widespread interest.

During the past three years this method has been carefully watched, freely discussed and criticised, and finally widely adopted. The literature has testified to the growing interest of and the encouraging results obtained by those men who have become really familiar with the method and who have given it thoughtful consideration. Most of the men more recently writing on this subject have confirmed the soundness of the principles upon which this method of diagnosis and treatment rests: Brown (5), Smithies (47), Whipple (49), Simon (45), Sachs (43), Friedenwald (13), Synnott (48), Levin (27), Kohn (25), Niles (35), Pope (39), White (50), Selman, Martland and Synnott (44), Kiel (24), Garrett (16), McCaskey (29), Hahn (18), Gibson (17), McClymonds (31), Nisbet (36), Hemmeter (21), Aaron (1) and others. Perhaps it is not wise for me to say that these men have *experimentally* confirmed

the soundness of the fundamental principles of this method. Yet they have given interesting and conclusive confirmation of most of the statements which I have already published.

On the other hand, certain writers (Einhorn, Crohn *et al.*, Dunn and Connell, Bassler *et al.*), as a result of their experimental observations, have attacked the very roots of the method, although in their writings it also becomes clear that they have likewise confirmed a number of the observations which I mentioned in earlier papers. Willy Meyer also endorses Einhorn's views. Certain of these published criticisms are so important as to require careful answering. This I propose to do, and shall attempt without bias to set forth a clear exposition of their attitude and shall attempt to show how it is wrong. No one is more interested than I am to determine the scientific truth of this method. If it is fundamentally wrong the sooner this can be realized and corrected the better, for the striking beneficial results to be gained from its use must then be explained on other theoretical principles.

After reviewing the writings of these critics I believe it is pertinent to say that they are attempting to draw counter-conclusions as a result of a misinterpretation of their findings, which are based upon series of cases either insufficiently studied or too small to permit them to realize their errors, or because they have attempted to modify the original technic usually in the direction of shortening the time and lessening the labor involved in a diagnostic or therapeutic medical drainage of the gall-tract.

In other words, they are not really performing a diagnostic drainage as it should be done in order to obtain the maximum diagnostic evidence. This method cannot be *diagnostically* simplified without grave danger of error. In the future, as we extend our knowledge of physiological chemistry of the bile, it may have to be still further elaborated.

Fundamentally this method falls within the field of gastro-enterology, and gastro-enterology in turn must be the handmaiden of a sound and extensive general and clinical knowledge which has grown out of preliminary years of work in the laboratory, outpatient service, hospital wards, and private practice. The diagnostics of this kind of work can be best developed by the gastrointestinal clinician who has a sound scheme of general and special diagnosis, who preferably either does his own laboratory work or sees that it is done by personally trained technicians and who makes a daily point of insisting that all laboratory specimens be examined *immediately*, and routinely tested microscopically, culturally, and bacteriologically.

Some will say this is highly specialized work and requires unusual specialistic knowledge. This is true. This is no field of diagnosis

for the tyro, nor can it be simply or successfully done by house doctors or nurses in the wards and the materials then turned over to the general laboratory *unless* the various people engaged in this division of labor are properly trained and have a thorough understanding of what each one's part shall be and unless the whole scheme of such organization, whether in the office or in the hospital, is sufficiently supervised and coördinated. Much of the criticism that has come about is due to a disregard of these facts.

In diagnosis and treatment in this particular field there is just the same difference between the veriest beginner and the man who by patient day by day plodding has become an expert, as there is between the relatively untrained hospital intern who may successfully handle an occasional acute surgical emergency and the fully rounded surgeon who has acquired a Deaveresque mastery of his art.

Medical internists seeking to accomplish a real success in their non-surgical management of gastric and duodenal ulcers, gall-tract and intestinal disease which we are now learning must often be technically and topically treated rather than extensively (and often uselessly) drugged, would do well to follow the example of the surgeons who have gradually trained their hospital groups to a definite detail of technic not only in their operating rooms but extending into their surgical wards.

Thanks to the pioneering efforts of surgeons during the past fifty, but more particularly during the past twenty years, the results achieved have been brilliant. Much has been accomplished in conquering gall-tract disease. Much more still remains to be done. Many are now frankly disappointed with the present status of surgery in this difficult field. The mortality rate has steadily been decreased from 50 to 10 and even to 5 per cent in the best surgical clinics; but still far too many surgical cases relapse for various reasons, and reoperations are too frequently required, often with worse results.

Very little has been accomplished until recently in the *prevention* of gall-tract disease, due to our previous inability to diagnose it in its incipieny. Following Meltzer's discovery of the local effect of magnesium sulphate applied to the duodenum we found this principle could be successfully carried out by means of the duodenal tube. Medical interest has been revived and medical industry has proved it possible to diagnose gall-tract disease more accurately in its early stages and to treat it successfully. Prevention of serious late gall-tract pathology, due to infection and stasis, with adhesions, stone formation and cancer, becomes more nearly within our grasp.

Closely wrapped up in this field are problems concerning certain diseases of the pancreas, the spleen, the liver and the major gastro-

intestinal tract which we are hopeful of solving. The field is open, but there is a shortage of labor. Much clinical experimental help in the solving of these problems can again come from the surgeons. Here the medical and surgical fields closely touch one another. What we need now is open-mindedness and a closer and more sympathetic coöperation between physician and surgeon for the common interest of our patients.

You are now familiar with the fundamental principle upon which this method depends and of my classification of "A," "B" and "C" biles from ducts, gall-bladder and liver.

This method offers the surgeon in his every-day problems of gall-tract disease: (1) The advantages of a more intimate and accurate preoperative diagnosis—a better foreknowledge of what he may find at the operating table (see Chapter XVIII). (2) A better chance of selecting those cases for whom surgery is imperatively indicated and those cases for whom surgery is contraindicated, but for whom this method of drainage can be made an alternative measure with reasonable hope of success. (3) The selection of cases on whom this method may be temporarily used to improve the surgical risk or to tide them over a temporary surgical contraindication. (4) The selection of those patients who may postoperatively be protected against surgical failure by a continuation of their drainage by this means beyond that secured for them by surgery alone. (See Chapter XXIII.)

Having completed a diagnostic drainage, or *several* of them if necessary, we should first decide whether the case is emphatically and unquestionably surgical and nothing else; or if we can prove by this diagnostic test that we can secure an efficient medical drainage of "A," "B" and "C" biles, we are then in a position to offer an alternative plan of treatment. Next we review the diagnostic *details*. If we find and can prove that the ducts, as well as the gall-bladder, are infected and catarrhal, we urge a period of medical drainage be carried out for several weeks in order better to prepare the patient for subsequent operation. Especially is this true if the patient is jaundiced.

As an example, this plan was carried out on a toxic, deeply jaundiced patient having an impacted bile valve stone in his common duct. After the stone impaction was released, I succeeded in recovering after twenty-six hours' drainage $4\frac{1}{2}$ liters of a dark, mixed, unsegregated bile, containing very viscid, stringy and lumpy plugs of mucopus and inflammatory débris, and secured a marked decrease of his jaundice and easement in his pain in twenty-four hours. By this means I withdraw from the body large quantities of poisoned bile just as the surgeon does in a cholecystostomy, and thereby lessen the toxic dose that is being carried by the blood to

heart-muscle, kidneys and liver cells, and also protect the intestinal tract against transplanted infection. This unquestionably should be a help to surgeons in still further reducing their operative mortality.

I recommend, and, in my practice, insist that all cases operated be given a medical drainage six to eight weeks later to determine whether operation has given a maximum satisfactory result, or whether medical postoperative drainage should be carried on for a few weeks to take care of residual duct infection and prevent the necessity of reoperations, which are now so frequent and so trying to surgical skill.

Thus by combining two methods of attack, the principles of free drainage of infected and inflamed gall-tracts can be continued beyond the time limits usually defined by surgical measures alone. Indeed in cases of my own, in which I found the ducts infected *prior* to operation, I will begin postoperative medical drainage at the end of the third week. This not only helps to cure the gall-tract disease, but protects the intestinal tract against transplanted infection, a not infrequent postsurgical sequela.

I can now offer an alternative method of gall-tract drainage in cases in which there are grave surgical contraindications, such as severe myocarditis, nephritis, hepatic cirrhosis, diabetes, hyperthyroidism, gall-tract disease complicating acute infectious fevers (such as typhoid cholecystitis); pernicious or grave secondary anemias or hemolytic jaundice with splenomegaly, the asthenic visceroptotics with gall-tract infection and biliary stasis and empyema in the aged or very feeble patient. None of these is a good operative risk, yet heretofore nothing of practical value could be done for them.

I have had some experience with each of these groups. With certain of them non-surgical drainage alone has achieved remarkable success and brought about a recovery without the need for operation. In certain others who presented very pronounced surgical contraindications for immediate operation non-surgical drainage has tided them over the immediate period and has so improved them that they have successfully been operated upon subsequently with as yet no mortality.

I have succeeded in closing up by medical drainage, coupled with autogenous vaccine therapy, several postoperative persistent biliary fistulæ, where previous surgery had failed.

Finally, this method has achieved a very considerable success in the treatment of certain medical conditions in which surgeons are not directly interested. I refer to biliary migraine, to biliary cirrhosis with or without intestinal autotoxemia, to catarrhal jaundice, to chronic arthritis with a low grade focus of infection in the gall-

tract and intestines, but in whom teeth, tonsil and sinus foci have been removed without improvement, to the clearing up of typhoid carriers, to gall-tract poisoning associated with the severe anemias.*

You will say, "How can you do all these things when there is still some controversy as to whether you can actually drain the gall-bladder by this method, granting that you *can* drain the ducts and liver?"

Let me try to answer this, now, by presenting for your consideration an analysis of the criticisms of the chief antagonists to this method in the order of their publication. All of these several critics attacked the method at one of its vital points, namely, that it is not possible by the use of magnesium sulphate locally introduced to empty the gall-bladder of its fluid contents; in other words that we cannot medically drain the gall-bladder.

Max Einhorn, of New York, bases his contention upon his observations in the use of magnesium sulphate, as well as numerous other salts and other substances, including sodium sulphate, sodium citrate, sodium chloride, magnesium citrate, sodium bicarbonate, calomel, mercurochrome, peptone and glucose solutions (and to this list Bassler has added hydrochloric acid), and states that when solutions of any of these substances are locally introduced into the duodenum that in varying degrees they encourage a flow of bile from the common duct and in varying degrees give rise to a play of colors from light to dark and back to light again, as I have described in my A, B, C sequence.

These points I have never denied, but have even previously to Einhorn's publications, and again since then, studied the effect of all of the substances he mentions, and in addition a number of other so-called cholagogue or secretagogue groups, and I came to the conclusion that of them all magnesium sulphate had, first, the greatest power to relax the duodenal wall, and, if not by specifically relaxing Oddi's so-called sphincter, at least by releasing the pressure on the common duct as it diagonally perforates the duodenal wall, permits bile to be discharged from the common duct; and, secondly, that of all these substances magnesium sulphate (and occasionally olive oil) acted best in its delivery of the dark, certainly the darkest, colored B bile, and apparently has a chemical hormonal influence upon the gall-bladder musculature which the others do not possess in a like degree. I find that a solution of peptone, representing one of the true physiological hormones, comes next in the series, and that hydrochloric acid (and nitrohydrochloric acid), used by Bassler in his argument, then follows. Hydrochloric acid, no doubt, acts as a stimulant to secretagogic activity of the liver, by converting pro-

* The citation of cases illustrating all of the above groups may be found in Chapters XXVII to XXXVI.

secretin into secretin, and I agree with Bassler that this increases the velocity of bile discharged, but I contend that this action more concerns the liver than the gall-bladder, and that it does not give rise to the same delivery of the dark bile, which (with certain exceptions to be mentioned later), I maintain is derived in large part from the gall-bladder.

Max Einhorn, in his second paper on this subject (11) says: "In a paper recently published it was shown, as first stated by Lyon, that magnesium sulphate when injected into the duodenum usually provoked a color reaction in the bile. The reaction in most instances takes place gradually, reaches an acme of color intensity (becoming very dark), then step by step diminishes, returning to a light yellow. The dark bile did not appear to be real gall-bladder bile as Lyon assumed for the following reasons.

"1. If the color change of the bile was due to the action of the magnesium sulphate on the gall-bladder, causing an emptying of its contents, the change of color would necessarily be an abrupt one, beginning and ending sharply. This is not ordinarily the case."

Comment.—There is obviously no soundness to this argument unless applied to a gall-bladder wall possessing a normal tonus, and under a certain degree of tension. Under such circumstances the transitions from A to B bile may be abrupt, and the latter may, indeed, occur as the first bile of recovery, especially in cases in which we find Oddi's sphincter relaxed when we reach the duodenum. Furthermore, the healthy gall-bladder possesses a normal tonus, and as its fluid contents are not large, it often possesses the power to empty itself as a result of a single stimulation with magnesium sulphate, and the transition to the light lemon C bile is then quite abrupt and further stimulations will not recover any additional dark bile.

This first argument of Einhorn certainly cannot apply to the functional state of atony of various degrees, in which the gall-bladder musculature is so lacking in tonus as neither promptly to deliver its bile, causing a sharp or gradual transition from A to B, nor to empty itself completely and it may require a *series* of stimulations before this result is achieved. During the intervals between the expulsion of the darker gall-bladder bile the lighter liver bile will be collected.

Again this argument is not tenable in pathological states of partial obstruction of the cystic duct, especially when accompanied by a deficient *vis a tergo* from a weakened gall-bladder wall. Why should the dark bile, in either of these conditions, have to appear abruptly and to disappear abruptly in order to be considered gall-bladder bile? It would be more logical to expect it would not.*

* See page 332.

"2. Magnesium sulphate, which is believed by Meltzer (34) to relax Oddi's sphincter, and by Lyon to cause the emptying of the gall-bladder, would in this way have no direct effect on the character of the bile evacuated. Solutions of 25 per cent or 10 per cent of magnesium sulphate would, if the emptying of the gall-bladder is accomplished, furnish a bile of identical color and other qualities. This, however, is not the case. The stronger the magnesium sulphate solution the darker the color and higher the specific gravity of the bile, indicating that the magnesium sulphate has a direct influence on the bile itself." **Comment.**—(1) In my personal work I do not allow the magnesium sulphate to be retained, but use it largely for the purpose of stimulation only and recover by gravity siphonage from 60 to 80 per cent of the amount introduced, so that, as a rule, the amount retained is small. (2) I do not get an increased amount of the dark bile in proportion to the amount of magnesium sulphate retained. (3) In not a few instances I have recovered dark bile in a sudden gush without using any magnesium sulphate or any other chemical. These cases are comparatively rarely seen and occur in patients presenting clinical symptoms suggestive of gall-bladder distention or in jaundiced patients without complete bile obstruction, and in both of these groups of cases the gastric acidity has been found high and more frequently than usual is discharging spurts of this high acid gastric juice into the duodenum. This observation is in accord with the theory of the hormonal effect of the gastric fluid, which is still further augmented when acting upon proteins.

The very fact that Einhorn assumes that solutions of various strengths of magnesium sulphate should furnish a bile of identical color and other qualities is an argument in favor of my contention. It is true that weaker solutions of magnesium sulphate will not deliver as much of the dark colored bile as will stronger solutions. I have tried this salt in 5 per cent volumetric solutions up to complete saturation, but believe that, for practical purposes, after we pass a 33 per cent volumetric solution the gall-bladder response to higher strengths is relatively so little greater as not to warrant their use. Einhorn in the paragraph above confirms this statement when he says "the stronger the magnesium sulphate solution the darker the color and the higher the specific gravity of the bile."

In regard to making any deductions as to the presence of gall-bladder bile by estimating its specific gravity *after* the use of magnesium sulphate, I am entirely in agreement with Bassler that this is a waste of time, even though the specific gravity readings are made after the magnesium sulphate has been entirely precipitated out of the bile solution by the addition of barium hydrate, which Einhorn did not do. The specific gravity of the bile will naturally be increased by the concentration of the contained magnesium sul-

phate, nevertheless I find that it is true that as a rule the specific gravity of the darker gall-bladder bile is higher than the liver biles, and even higher than the more static biles occasionally encountered in the common duct, if such biles are tested before stimulating with magnesium sulphate or introducing any other fluid or chemical substance into the duodenum.* In this I find my work in agreement with the experimental work of Rous and McMasters, (42) whose observations have shown that one of the chief functions of the gall-bladder is to concentrate the bile after it is received from the liver. These authors hold that the normal gall-bladder can concentrate nearly ten times its volume of liver bile.

"3. A great many of the salts (which have no relaxing action), like sodium sulphate, bicarbonate of soda and other chemicals, act in a manner similar to that of magnesium sulphate, affecting the color reactions named above. The latter must be due to the action of these ingredients on the liver and the bile production, and not to a mere evacuation of the gall-bladder contents."

Comment.—As I have stated above, many of these salts do act "in a manner similar" to that of magnesium sulphate, but they have by no means the same power to deliver as much or as dark a colored bile, because they do not influence the gall-bladder musculature to such a degree.

"4. After applying the magnesium sulphate test an immediate repetition of the test frequently provokes a reiteration of the same reaction with its entire series of color plays. If the dark bile would be gall-bladder bile the reaction could not take place anew right after the gall-bladder had emptied its contents."

Comment.—I have already answered and shown the fallaciousness of this view in my comment after Einhorn's first argument, and have shown that it is possible for such a sequence to take place in conditions of atony of the gall-bladder or of partial obstruction of the cystic duct. (See pages 129 and 332.)

"5. Patients whose gall-bladders have been removed frequently give similar reactions after magnesium sulphate instillation, clearly showing that the gall-bladder as such can have nothing to do with this phenomenon of color changes in the bile."

Comment.—This observation is both right and wrong. It is wrong in the fact that so far, in over 8000 observations, I have rarely seen a cholecystectomized patient delivering the extreme shades of deep green-black bile which appear so frequently in patients still retaining their gall-bladders, and particularly in those patients who show the greater degrees of atony, or in those patients who at operation are found to have small but incompletely fibrosed gall-

* See pages 80 and 134.

bladders, and which still contain small amounts of thick, dark olive-green or tarry-black bile.

Einhorn's observation is right, and my comment here applies equally well to Bassler, who also uses this argument, that occasionally the cholecystectomized patient will deliver a darker colored bile that resembles either the deeper shades of normal gall-bladder bile or, at times, even a greater depth of color. I have found that in the occasional cholecystectomized patient from whom I have recovered a bile dark enough to resemble "B" bile that this phenomenon has usually occurred in the cases with jaundice (more often chronic jaundice which produces marked swarthy skin due to slow absorption of bile poisons); caused by biliary obstruction in the finer hepatic bile radicals, or it has occurred in cases in which at secondary operation the common and hepatic ducts were found dilated and containing static bile, or in whom diverticuli had occurred.

This latter fact is in accordance with the observations of Hartman (20) and his coworkers, who found that in dogs upon which they had made a *high* ligation of the cystic duct, in the postmortem studies several weeks or months later they were able to demonstrate in a number of their animals a definite dilatation had taken place at the end of the cut cystic duct, and that in such a dilated point they would find the bile darker and more static than in the rest of the ducts. Indeed this diverticulum in certain of their dogs seemed to approximate a regeneration of the gall-bladder. Where the cystic duct had been ligated at its *lower* end, near its union with the hepatic duct, they found diverticuli might occur at any point within the hepatic or common duct, and not alone at the stump of the cystic duct.

To ascertain and acquire an adequate appreciation of these facts requires clinical experience with medical gall-tract drainage covering several hundred cases. Isolated observations are often dangerous if put on record too soon. Indeed in the excellent study of the single case of hepatoduodenostomy, without a gall-bladder or common duct and with shrunken hepatic ducts as reported by Dunn and Connell (9) you will find that the whole recitation of this case points to a well developed biliary stasis or biliary cirrhosis from long continued biliary obstruction, and would thus bear out my contention. This patient of Dunn and Connell's had had her gall-bladder removed four months before coming to them, and during their handling of her case 14 *additional* operative procedures on the gall-tract were carried out, so that it would appear quite likely that the bile delivered through their fistula following the use of magnesium sulphate should be a dark bile due to stasis occurring within the liver itself. Their assertion that magnesium sulphate, when

introduced into the jejunum, gave rise in this patient to a recovery of this dark bile is doubtless true. It probably would not matter at which part of the gastro-intestinal tract (perhaps except the stomach) the magnesium sulphate was introduced, or even if it were introduced intravenously, for I should imagine the only type of bile they would recover from such a case might be a deeper colored bile occurring as a result of intrahepatic stasis. I have experimented with introducing the magnesium sulphate into the rectum with the tube in the duodenum, and find that it will deliver a transition of "A," "B" and "C" biles, but the response in the securing of "B" bile is by no means as great as occurs when this salt is introduced directly into the duodenum.

As I have stated earlier, I believe that a close reading of Rous and McMaster's papers (42) will show that they have conclusively demonstrated that the gall-bladder possesses the function of concentrating liver bile in a higher degree than does any other part of the gall-tract. They find that it will concentrate ten times its volume of liver bile. This provides the safety valve for the whole system. Otherwise spontaneous rupture of gall-bladders would be more likely to occur. When this functional capacity of the gall-bladder has been exhausted or prevented some further concentration of bile can and does occur in the ducts.

They also found that they must obstruct from 75 to 95 per cent of the total secreting surface of the liver before they can produce jaundice in their experimental animals. In the event of bile obstruction when the gall-bladder has been ablated, its concentrating function as well as its storage function must be vicariously carried on by the ducts and later on by the liver.

It is to be noted in this second paper of Einhorn's, which I have just discussed, that he has receded from the position which he took in his first paper, (12) in which he quite as strongly concluded that the dark colored bile was produced by an undefined action of the liver due to the absorption of the sulphate radical of the magnesium salt, and strengthened his conclusions by his observations that a similar but lesser play of colors could be produced by the use of sodium sulphate, and that this play of colors was produced in still less degree by sodium phosphate, sodium chloride, magnesium citrate and other salts which did not contain the sulphate radical. He has doubtless since become aware of the fallacy of this conclusion. Indeed it would seem that this should have occurred to Einhorn as not being the explanation when he stated in his first paper that "by injecting 60 cc of the peptone solution into the duodenum the bile outflow resembles very closely that after the magnesium sulphate. Here, too, the color play appears gradually and not abruptly." Of course, here he was using the normal physiological hormone as experimentally shown by Rost. (41)

In looking over Dr. Einhorn's figures in his case reports I note that he reports practically all of his biles as being alkaline in reaction, and goes further to state their alkaline titer. I do not know by what methods he performed this work, nor what indicators he used, but it nevertheless surprises me, for I find that the bile is not, as a rule, an alkaline fluid, as has been so commonly stated, but is acid, and its acidity range I have found to vary between 25 and 45 degrees of acidity when titrated to phenolphthalein. The acidity of the bile before stimulation with magnesium sulphate, while distinctly acid to the degrees I have stated above, when tested after stimulation will be found to have increased its acidity. Some of this is no doubt due to the magnesium salt, since the acid titer of the volumetric 33 per cent solution averages about 10 degrees, but in addition to this the increased acidity may be partly due to a greater expulsion of gall-bladder bile. While the pure bile itself is acid to phthalein, it is probably due to its contained bile acids, for in no case has free hydrochloric acid been detected except where the bile is mixed with gastric juice.

In regard to the physical property of the specific gravity of bile, I have found that the range of specific gravity of bile entering the duodenum *before* stimulation by magnesium sulphate or by any other chemical varies between 1.013 and 1.040, and that here the color intensity and its specific gravity have a tendency to run more truly parallel, that is, that the deeper colored biles usually have a higher specific gravity. On the contrary, after testing them *after* duodenal instillation of magnesium sulphate I find that the color intensity of the bile and its specific gravity do not necessarily run parallel. The lemon "C" biles have been found in certain instances to have a higher specific gravity than the browns or green-blacks. Where washing the duodenum has been practised to flush out the magnesium sulphate, in certain instances the terminal lemon-yellows may contain more magnesium sulphate (when precipitated by barium hydroxide) than do the darker "B" biles. This is supportive evidence in favor that the magnesium sulphate may be absorbed into the portal blood stream and be carried to and eliminated again by way of the liver. The specific gravity of a volumetric 33 per cent solution (actually a 16 per cent solution) of magnesium sulphate averages 1.120. Therefore it is natural to find the range of specific gravity of bile considerably higher after magnesium sulphate instillation.

Magnesium sulphate plus water plus barium hydroxide precipitates as magnesium hydrate and barium sulphate. This can be used as a quantitative test for determining the magnesium sulphate in bile as follows: 0.5 cc of bile and 9.5 cc of distilled water are mixed. Add 1 drop of a saturated solution of barium hydroxide.

Magnesium sulphate is present when a heavy, curdy cloud is formed. The bile salts also go down as a finely granular precipitate. It is possible to reduce a bile of a specific gravity of 1.040 (after the use of magnesium sulphate) by the gradual addition of the barium solution to 1.003, leaving a crystal clear, colorless fluid. The barium hydrate apparently removes the bile pigment.

I believe these facts, in addition to what I have stated earlier, show the fallacy of Einhorn's first theory that the dark colored bile after stimulation with magnesium sulphate is due to the absorption of the sulphate radical by the liver. Furthermore, Dunn and Connell state their belief that the deepened color of the bile is due to the fact that the liver absorbs the *magnesium* and not the sulphate radical of magnesium sulphate. Of course, Einhorn and Dunn cannot both be right. I believe them both to be in error for the reasons stated above.

Dr. Einhorn, furthermore, considered that in view of his hypothesis magnesium sulphate might therefore be made a functional test for liver activity. Perhaps there is some better grounds for believing this, but more work must be presented before this can be accepted. Probably of all functional liver tests so far at our disposal the recently introduced phenoltetrachlorophthalein test offers the greatest possibilities. This method, combined with the duodenal enzymic tests, as recently elaborated by Bergeim and his coworkers (see Chapter XV) may be very helpful to us in our better understanding of the physiological chemistry of the hepatico-pancreatico-gastro-duodenal tract.

Now let us consider the criticism of Crohn (6) and his associates. In their most admirable paper they have presented the results of their careful investigations into the premises upon which the rationale of this method is based. The appearance of such a paper as theirs should be welcomed because it shows the true investigative spirit and an attempt at a logical interpretation of the experimental data which they collected. Their conclusions are based upon a study of a series of cases, the actual number of which is small, and, even further, subject to doubt, for they state, "We therefore have attempted in a series of 50 or 60 clinical cases of gall-bladder disease to gather data, etc." Here there is a 20 per cent error, which is still further increased when later on I find them saying, "Of this series of 70 cases." Therefore it is natural to have a feeling of doubt as to the actual number of cases which they studied. This, however, is a comparatively small point.

They start out to establish a platform (?) that "the function of the test (Lyon's), and its therapeutic application, depend on the successful demonstration of all of these premises.

"1. Demonstration of the presence of a functioning sphincter at the mouth of the common bile duct.

"2. Demonstration that rhythm and contractions of the gall-bladder walls and simultaneous relaxation of the sphincter action at the papilla are both controlled by contrary acting systems of innervation.

"3. Evidence to show that magnesium salts cause relaxation of the smooth muscle of this sphincter when applied to the duodenal mucosa, and thus reflexly cause contractions and emptying of the gall-bladder.

"4. Evidence that the fluid obtained is really gall-bladder fluid, and the changes in color, consistency and amount indicate disease.

"5. Evidence that cytological, chemical and bacteriological examination of this fluid is both possible and feasible and leads to dependable conclusions regarding gall-bladder pathology."

Comment.—Each of these five premises is not only fair, but, singly and collectively, failure to prove them would strike hard at the fundamental soundness of this method. I shall therefore have to detail their discussion of these five premises and add my own comments.

Premise I.—In regard to the presence or existence of a papillary sphincter. They review the work of Oddi, (37) the Italian physiologist and surgeon, who in 1887 first described the augmentation of muscular bundles which occurred at the terminal portion of the common bile and pancreatic ducts ending at the papilla, and which have since been known as Oddi's sphincter. They then state Hendricksen's (22) confirmation of these findings, first on animals, and later in man. This has again been confirmed by Crohn and his coworkers (although they deny it), for they go on to say, "We have been able without difficulty to demonstrate microscopically in sections both in man and in the dog the existence of circular bands of smooth muscle fibers surrounding the common duct and its course through the intestinal wall. These transversely arranged bundles are continuations of the scanty musculature of the gall-bladder and first and second portions of the common duct. In the third portion they are thicker and more numerous; yet at no point do they form a compact circular bundle or a substantial sphincter, such as is our conception, for example, of the sphincter of the pylorus or the anal ring. The fibers of the sphincter of Oddi are scanty, widely separated and diffused, and are at no time continuous. Nor are they collected in a band at any one point, but are scattered evenly throughout the intramural course of the duct. The real anatomical sphincter, apart and separate from the inner circular coat of the duodenal wall, can hardly be said to exist."

Comment.—Crohn gives the inference that they have not been able to confirm anatomically Oddi's sphincter, later confirmed by Hendricksen, yet a reading of the paragraph above will show that they have confirmed it. For *why* should they expect to find as much histological development of a sphincter in such a small tube as the common duct, designed to hold back a column of fluid under relatively low pressure (8 to 24 inches) of water as would be expected of the pyloric sphincter which has to sustain a weight of one to several pounds when urged forward by the vigorous contractions of the more strongly muscled gastric wall, or indeed the anal sphincter which has to support the pressure from the intestinal column, and especially when placed at a point so vital to our existence in comfort without perpetual self-soiling? Nature did not design us that way.

However, these authors state that, aside from anatomical considerations, that "Physiologically, however, a sphincteric action at the papilla of Vater is demonstrable," and then proceed to quote the animal experiments of Mann (33), who demonstrated a resistance in the papilla equivalent to a pressure of a column of water of 100 mm., whereas Herring and Simpson (23) found this resistance at the sphincter due to muscular tonus was equivalent to a column of water from 200 to 300 mm. in height. That the sphincter tonus is even stronger than this is suggested by the observations of Archibald (1) who found that it would sustain a force equivalent to about 600 mm. of water pressure within the duct. In their experiments on dogs, in which they were aided by Dr. L. Auster, they (Crohn *et al.*) were able to confirm some of the earlier studies of Rost and noted "that during digestion in the dog the flow of bile from the papilla was slow but practically continuous and consisted of bile from the liver." They do not give any reasons, however, for believing that the bile was from the liver alone, unless it be that they did not see the gall-bladder contract or otherwise empty itself, which is not a sufficient reason, as I will show later.

Further they say that: "By drawing the finger even gently across the papilla, or by application of faradic stimulation or chemical irritants, it was seen that the sphincter promptly closed the duct. An interval of between ten and thirty seconds elapsed during which the papilla was erected like a mammary nipple. Then a relaxation took place, and the flow of bile was reestablished. Not only the papilla but also the surrounding segment of the duodenum responded to the stimulus. If the stimulus was strong enough, the whole segment became tonically contracted; if weaker, only the papilla and adjacent musculature. Thus we were able to demonstrate a definite sphincteric action, though not actually a certain anatomical sphincter."

Comment.—Therefore Premise I in regard to the presence or existence of a papillary sphincter seems to have been definitely established. Furthermore, in the last paragraph just quoted it is interesting to see how closely these experimental observations support certain clinical observations in regard to regurgitation of bile into the stomach brought about by reverse peristalsis as a result of direct duodenal irritation, or of reflex action of disease in neighborhood viscera, anatomically or neurologically connected. This tendency to biliary regurgitation I have clinically confirmed repeatedly in cases of duodenitis, gastric and duodenal ulcer, cholecystitis and appendicitis.*

Premise II.—Nervous control of contractile tissues of gall-bladder and papilla. Here Crohn and his associates are attempting to disprove the "law of contrary innervation," as it was theoretically expounded by Meltzer, (34) in its application to the biliary systems, and state that "this law, interpreted in terms of gall-bladder and sphincter, would call for a double innervation, splanchnic and parasympathetic, to both the gall-bladder and the papillary muscle. Thus, the same stimulus that traversed the vagus system to cause contraction of the gall-bladder would simultaneously relax the sphincter; or, traveling through the splanchnic system, would contract the sphincter and relax the gall-bladder. And they show that physiologists are not in accord in their results experimentally produced on animals by quoting the divergent conclusions reached by Doyon, (9) and by Bainbridge and Dale, (3) who repeated the same experiments eleven years later. They are, therefore, entirely right perhaps in saying, "A clear-cut laboratory demonstration of the law of contrary innervation as applied in this field remains to be desired." But they go on to say that, "It is more than likely, however, that some such regulatory apparatus does exist, similar to that in the intestinal tract, ureter, esophagus, etc."

Comment.—Meltzer was aware of this for he says in his thesis (34) that the innervation of the concerned parts is not yet settled in its details and then proceeds to quote Doyon's findings. But surely all theoretical reasoning, as well as numerous clinical observations of human beings in health and disease, point to such a mechanism, even though it has not been experimentally confirmed. Nor will it, in my judgment, be experimentally confirmed unless the experimental physiologist deviates from the methods provided by legal vivisection and does not narcotize to pain insensibility his experimental animals. This change in method cannot and *should* not take place, but even were it done there would still be the question of accounting for the abolition of these physiological reflexes by the cutting of the

* See page 257.

splanchnic or the terminations of the parasympathetic innervation, by incising the duodenal wall or by cutting the gall-bladder in order to insert the customary balloons. This abolition of the normal reflex has been shown to take place by Rost, (41) as well as by countless postoperative observations of surgeons and others who find that after cholecystectomies the crossed innervation must be injured because the sphincteric control is abolished and bile is being constantly discharged into the duodenum.

This now brings me to a discussion of one of the strongest arguments advanced by Crohn. They state that, "In the experiments performed with Dr. Auster, we injected into the bladder cavity of dogs narcotized with chlorbutanol, a small quantity of a solution of methylene blue in physiological sodium chloride solution. This we did to differentiate gall-bladder bile from the flow of liver bile. The duodenum was then opened and the papilla exposed for observation. It was noted that though the flow of bile is almost continuous after a meal, this bile consists entirely of liver bile, the blue discolored gall-bladder bile not appearing at all except when *manually expressed*. Cholagogues and solutions of salines and peptones had a tendency to encourage this flow of liver bile; but we found no agent (presumably this includes magnesium sulphate), applied in the duodenum, that caused the expulsion of the gall-bladder contents."

Comment.—This is an important statement for which some explanation must be furnished. This experiment of theirs is similar to experiments which we have conducted at the operating table on patients in whom a duodenal tube had been passed to the proper point prior to anesthesia, and with the abdomen open no visible contraction of the gall-bladder could be observed following the local application of magnesium sulphate to the duodenum given through the tube. Nor could the darker colored bile be recovered until after the gall-bladder had been emptied by manual pressure. I well remember my intense disappointment at this failure of demonstration of Meltzer's law in my first participation (about May, 1920) in such an experiment on a patient operated by Dr. George G. Schwartz, and I confess then that my belief in the fundamental soundness of this method was shaken until I had had time to think. In my comments now I shall attempt to answer not only the argument of Crohn, but also that of Luckett, the surgeon who appears as a cocontributor in the paper of Bassler. (4)

The first question which might naturally arise is how great a part does the third stage of anesthesia play in inhibiting the reflex activity of unstriped muscle? We know that in full anesthesia all reflexes are abolished. The true physiological function of any of the *hollow viscera* has not been finally fixed by any study of fully

anesthetized laboratory animals of which I am aware. We also have much accumulated clinical evidence that this theoretical antagonistic innervation of the gall-bladder is a mechanism which is easily upset, and it seems but natural then that it would be obtunded or abolished by a general anesthetic. I see no possibility of proving this point until the physiologists have come to some definite agreement in their findings. At present this situation is still *sub judice*. Perhaps clinical or laboratory experiments conducted under local anesthesia might give different results from those recorded above. But here we would still have to reckon with the difficulties of interpretation following an abolition of these physiological reflexes due to injury to the terminal nerve supply of the duodenum and gall-bladder by surgical cutting or trauma from manually or instrumentally exposing the field and handling the viscera.

However, in both Crohn's and Bassler's papers, by these very experiments they go far to establish the validity of my conception that magnesium sulphate, when applied locally to the duodenum, is more nearly a true chemical hormone for gall-bladder expulsion than is any other chemical, for you will note that in Crohn's experiment they were not able to demonstrate the appearance of methylene blue until *after* they had manually compressed the gall-bladder, and in each of the six operative experiments conducted by Luckett it is to be expressly noted that *after* manually compressing the gall-bladder the *darkest colored bile* was obtained by aspiration. Luckett's experience is entirely similar to that of my own in the experiments which I have attempted with Schwartz and other surgeons. This very fact of the recovery of the darkest bile after manual pressure of the gall-bladder should entirely controvert the assumption of Einhorn that the darker colored bile is derivable from the liver and not from the gall-bladder.

That magnesium sulphate applied locally to the duodenum under such anesthetic and operative conditions should fail to produce an A, B, C sequence is not surprising in view of what I have said above in regard to the effect of anesthesia and injury. Nevertheless the manual expression of the darker bile directly from the gall-bladder is so similar to that recovered by the magnesium sulphate method when applied to normal human beings, non-narcotized and non-traumatized, as to lend further corroboration that magnesium sulphate acts for this purpose better than does any other chemical.

Finally, we have to consider the fact that Sachs (43) has apparently first succeeded in successfully visualizing gall-bladder evacuation where all the others have failed. In his recently published paper he reports the following case:

"CASE.—Mrs. A. H. Referred by Dr. G. Simanek. Medical drainage three days prior to operation showed 'A' bile a light golden-yellow; 'B' bile a dark static bile; 'C' bile a light, lemon-yellow. Through the kindness of Dr. Simanek, I was permitted to pass a duodenal tube before she was anesthetized. She was then brought to the operating room, anesthetized, and the usual gall-bladder incision made. The gall-bladder was exposed, and found to be fairly well distended, and before any exploration was made, 50 cc of a $33\frac{1}{3}$ per cent solution of magnesium sulphate was introduced directly into the duodenum through the duodenal tube. The suction bottles were applied in the usual manner, and in three minutes bile started to flow. In five minutes we started to get a real dark, golden bile (typical 'B' bile) and the distended gall-bladder gradually collapsed. I might compare this to the collapse of a balloon when the air is released (no contraction was observed). The gall-bladder was then removed in the usual manner, and the bile in our collection bottle was apparently the same as that obtained from the removed gall-bladder, only in greater dilution. I grant that this was done under anesthesia and hence open to some objection; however, I offer it for what it is worth."

I was naturally elated when I read this case report, and took it for granted that this observation of Sachs and Simanek was reliable, since it supplied a suggestion of positive proof which had not hitherto been furnished. I have recently seen Dr. Simanek, however, who told me that they have since then observed this occurrence on two other occasions. Now, how can we account for this apparent discrepancy inasmuch as these cases were also observed under general anesthesia? It seems probable that we can look for the logical explanation of this in some of the teachings of Pottenger (40) in his excellent book on Visceral Disease, in which he broadens our well known clinical observations and shows that every individual is not possessed of the same degree of visceral neurological stability; that the necessary anesthetic dose which would obtund or abolish the visceral physiological reflexes in one individual might not do so in all. Therefore, in Sach's case it seems tenable to assume that the degree of anesthesia was not sufficient to completely abolish the crossed innervation to the gall-bladder and papillary sphincter. Indeed this is further suggested by the fact that in Lockett's third, fourth, fifth and sixth cases one or more aspirations of duodenal contents following magnesium sulphate showed a delivery of a *darker* bile, as though the gall-bladder were attempting to empty notwithstanding a partial obtunding of its neural pathways, although, as I have stated above, in none of his six cases was the recovered bile so dark as occurred after manually compressing the gall-bladder.

At the conclusion of Crohn's demonstration of the second premise he states, "We are also led to believe from our observations that the gall-bladder is a rather inactive organ which takes little part in the physiological production, storage, or expulsion of bile." In maintaining this contention they will have to controvert the conclusions of Rous and McMaster (42) derived from their very carefully observed and conducted studies. This applies likewise to Bassler, *et al.*, who also apparently ascribe a very small functional role to the gall-bladder.

Therefore from what has been said above it must appear that the validity of Premise II concerning the nervous control of contractile tissues of the gall-bladder and papilla has likewise been safely established.

Premise III.—Relaxation of smooth muscle of sphincter when magnesium salts are applied to duodenal mucosa and reflex contraction and emptying of the gall-bladder.

These authors admit that the "observations of Meltzer on the physiological and pharmacological action of magnesium salts are fundamental." They then proceed to mention some of Meltzer's experiments with magnesium sulphate, in which he could cause complete nerve blocking peripheral to the point of application; could prevent the occurrence of intestinal peristalsis with ergot and eserine when magnesium salts had previously been injected; the relief of the tonic spasm in tetanus following intraspinal injection of the magnesium salts; and noticed that when they were given by mouth to animals that its use then did not totally abolish the intestinal movements as when it was locally introduced, but merely depressed them. In addition to these observations, with which Crohn is familiar, it is a well-known fact that if a solution of magnesium sulphate is used as a diluent for a hypodermic injection of morphine sulphate it will prolong the analgesic effect of the morphine salt. I have no doubt that if magnesium sulphate were injected subcutaneously or intravenously that with a tube in the duodenum we would notice also an A, B, C sequence in bile flow.

It will be interesting to learn something more of Meltzer's point of view as shown in the following exchange of letters. I wrote him on May 8, 1920, a few days after I had first presented this subject before the American Gastro-enterological Society:

My Dear Doctor Meltzer:

I was exceedingly sorry that I did not have an opportunity to see you personally at Atlantic City last Monday. I had hoped to have an opportunity to talk to you after the dinner Monday night, but was unable to find you afterward and I did not see you on Tuesday, and presume you must have returned to New York. I wanted to ask you whether I had presented your views in regard to the physiology of the biliary mechanism accurately

and to acknowledge my debt to you for the suggestion you made in regard to the use of magnesium sulphate, which has proved such a helpful factor in opening up a much better field of investigation into the several biles, more especially that of the gall-bladder.

I have always been rather curious to know in regard to your experiments on dogs with magnesium sulphate, in which you noted the relaxation of the tonus of the duodenal zone, relaxing the common duct sphincter, *whether* you noticed at the same time any visible contraction of the gall-bladder musculature suggesting on its part an effort to empty its contents. I have been thinking for some time of the possibility of visibly proving this on human beings by getting a tube in the duodenum of a suitable patient about to be laparotomized for upper abdominal section, passing the tube into the duodenum and fluoroscoping its location before anesthesia. Then after the upper abdominal field is fully exposed to inject the magnesium sulphate into the duodenum and observe whether or not the gall-bladder shows any visible evidence of contraction. If you have already observed this in animal experimentation it would be interesting to check it up again on a suitable selected patient.

In regard to your Law of Antagonistic Innervation in discharging gall-bladder bile, it has seemed to me that this is fundamentally correct when interpreted by certain elements in gastric chemistry, or with definite chemicals, such as magnesium sulphate, but I feel sure that there must be a third factor beyond the simple relaxation of the duct and simultaneous contraction of the gall-bladder, namely, in a selective action that some substances have directly on the gall-bladder and others on the pancreas, both of which, to discharge their material, must have a relaxed duct sphincter. For instance, benzyl benzoate, belladonna, and perhaps potassium permanganate seem to have the power to relax the common bile duct, but apparently do not make the gall-bladder discharge its contents as does magnesium sulphate, at least with by no means the same amount of force or regularity. Similarly, our evidence seems to show that certain types of test meals, for instance, the carbohydrate meal, while relaxing the common duct, encourage a freer discharge of pancreatic juice and a less amount of gall-bladder discharge, whereas the products of acid gastric protein digestion, as Rost pointed out, do seem to favor a larger amount of gall-bladder contraction as well as a certain amount of pancreatic discharge. So it would seem to me that there may be a selective mechanism, somewhat beyond the fundamental application of the Law of Antagonistic Innervation, which, *a priori*, argues that when the common duct relaxes the gall-bladder must contract. I would very much appreciate having you write me your view in regard to this.

Yours very sincerely,

B. B. VINCENT LYON.

Dr. Meltzer's reply on May 11, 1920, is illuminating:

Dear Doctor Lyon:

I heard of your paper which you presented at the meeting of the Gastroenterological Association and was sorry to have missed it. On the forenoon of Monday, May 3d, I attended the meeting of the Association for Clinical Investigation, of which I was about a dozen years ago one of its obstetricians.

As to the action of magnesium upon the gall-bladder, neither have I seen, nor do I assume, that that salt causes a contraction of that organ. Since I have observed twenty-two years ago the striking soporific and relax-

ing action of an intracerebral injection of a few drops of a solution of magnesium sulphate, I worked on the theory that magnesium salt is the representative of the inhibitory effects in the animal body. My conception of the Law of Antagonistic Innervation had been formulated many years before my observation of the inhibitory action of magnesium. But I did state, I believe, in a paper read several years ago in Washington at a meeting of the Pan-American Congress that when magnesium sulphate comes in contact with sodium chloride it becomes in part converted into sodium sulphate, which, by its hematogenous action, may cause a constriction of some parts of a mechanism. But this is merely a speculation. But the bile in the gall-bladder as well as in the biliary ducts, is under a certain pressure which is sufficient to drive it into the intestines if the papilla of Vater is relaxed. I find myself in agreement with your view that various substances exert a selective action upon various organs and upon various parts of the same organ. The Law of Antagonistic Innervation is executed by a coördination of a variety of factors.

With cordial regards, sincerely,

S. J. MELTZER.

The following letter from Dr. Meltzer on August 2, 1920, and my reply of August 3, 1920, are also enlightening:

Dear Doctor Lyon:

I read your interesting article in the *New York Medical Journal* for July 3d and 10th. I feel grateful to you for starting your studies and congratulate you on your beautiful success.

Permit me to make the following remark. On page 26 of your article in the *New York Medical Journal* you say: ". . . the inference was plain that if this Law of Contrary Innervation was sound, anything which would cause inhibition of tonus of Oddi's sphincter must, *ipso facto*, cause contraction of the gall-bladder musculature." I may use your own words: "This is not so." The Law of Contrary Innervation applies only to the functions of organs of living animals; it does not apply to inorganic substances; it does not mean, for instance, that magnesium salts which cause a relaxation of one component of an organ must, *ipso facto*, cause a contraction of the antagonistic component in the same organ, or, barium salts, which as a rule, cause a contraction of one component, cause an inhibition of the antagonistic component. Only a combination of certain salts may accomplish this end.

I am carrying on experiments on this question and may have something to say about it later. If I obtain definite results, it will give me pleasure to let you know the outcome.

Sincerely,

S. J. MELTZER.

My Dear Doctor Meltzer:

I received your letter of August 2d, and I am very much obliged to you for writing me again your opinion in regard to your experiments and will certainly look forward to being kept informed as to what additional trend your further investigations will take. I do not believe that a sufficient portion of the medical profession appreciate thoroughly the tremendous importance of your studies, and I have endeavored to bring it home to each of the doctors that I have personally seen and written that this new field of

gall-bladder and duodenal work which is opening up so much better than formerly has been due so greatly to your pioneer experiments.

With very good wishes and trusting that you are in better health, I am,
Sincerely yours,
B. B. VINCENT LYON.

It is probable from this second letter of Meltzer's that even he did not realize that magnesium sulphate seems to possess a truer hormonal influence on the gall-bladder than do any of the other substances that have been yet tried.

As Crohn states: "It was natural, therefore, for Meltzer to think of applying the magnesium ion to the duodenal mucosa to relax locally the sphincter action. According to his conception of the double role of the innervation of the biliary tract such a relaxation of the sphincter should be accomplished by a contraction of the gall-bladder." . . . By referring to Meltzer's letter on page 143 it will be seen that Meltzer did not expect this, because he, too, was not able to visualize a contraction of the gall-bladder. Nevertheless his experiments, too, were conducted under full narcotization, and in addition subject to surgical trauma of the terminal innervations, and therefore of no use in determining the normal physiological reflexes.

At the end of this paragraph Crohn again mentions his failure to recover from the duodenum methylene blue injected into the gall-bladder, and the error in his interpretations of its meaning I have already answered. In his final sentence in this paragraph he states that "McWhorter (32) demonstrated a lowering of pressure in the common bile duct of from 50 to 100 mm. after magnesium sulphate had been applied to the ampulla; no result was seen after peptone solution."

Comment.—This observation further establishes my position that magnesium sulphate possesses some intrinsic property, hormonal or otherwise, that is not possessed by peptone or the other list of chemicals tried, which favors the evacuation of gall-bladder contents, if in no other way than by lowering the duct pressure. So it might appear from what has been said that Premise III has been established, certainly in regard to its true physiology when the normal physiological reflexes of unstriped muscle have not been aborted or obtunded by anesthesia or injury.

Premise IV.—That fluid obtained at bedside by magnesium sulphate lavage of duodenum is gall-bladder fluid, and that changes in color, consistency and amount indicate gall-bladder disease.

Crohn and his coworkers now lay aside experimental theoretical considerations and attempt to draw independent conclusions from the clinical application of the case. But they say: "The technic of

Lyon was simplified and adapted to hospital use. The tube (Einhorn duodenal tube) was passed either the night before or in the fasting state in the morning." They used, however, smaller amounts of a weaker solution, that is, 30 to 50 cc of a 25 per cent, presumably volumetric, solution of magnesium sulphate, which I as well as Einhorn have shown are not so effective as stronger solutions. Thereafter specimens were aspirated every five minutes for one to two hours "until the color of the bile returned to that obtained before the saline lavage or until it was definitely concluded that no change in color or character was taking place. Sometimes siphonage was practised to ascertain the amount of the 'B' bile obtained."

Comment.—In other words, they were not practising a medical drainage of the gall-tract as I believe it should be done. It is not wise to pass the duodenal tube the night before, for during the night it may be that duodenal irritation from the metal tip tube might cause relaxation of the duct sphincter and permit bile discharge into the intestines even during the fasting stage, and such bile would then be withheld from observation. Since the duodenum can be so rapidly intubated when a proper technic is used, it is not necessary to insert the tube the night before.

Furthermore, from a *diagnostic* viewpoint, I strongly deprecate the modification or simplification of technic in order "to adapt it to hospital use," because I have learned by a slow evolution that the *diagnostic* technic can not be simplified or shortened without assuming a risk of losing some of the information to be gained, and because I have learned from personal communications or personal talks with inquiring doctors that the reason for their failures is due most often to a faulty technic, or to an unwise modification of (usually an attempt to shorten) the original technic.

I also feel that it is impossible to attempt to gain an adequate diagnostic appreciation of a gall-tract drainage by intermittently (even at five minute intervals) aspirating successive specimens for purposes of comparisons. The observation of bile recovery should not be interrupted for even five minutes. It will usually flow quite readily by gravity, although at times siphonage is helpful. In studying a case one should remain by the bedside with a microscope, and carefully watch the sequence of bile delivery through an observation glass cannula, and make frequent microscopical, chemical and bacteriological examinations as indicated by gross changes in the bile and as mucopus flocculations are appearing.

Notwithstanding the practising of a faulty technic, Crohn and his associates nevertheless clinically confirmed the diagnostic soundness of this method in many of the cases which they studied, and no doubt would have been able to better interpret the findings in their doubtful cases if their personal experience with the method had

been larger. They met with off-colored biles in 65 per cent of their cases, and found at operation that 62 per cent of these cases were accompanied by a pathological condition, stones or chronic cholecystitis. If they, comparatively inexperienced, could secure 62 per cent of preoperative pathological diagnostic suggestion, even this comparatively low percentage would substantiate the clinical usefulness of the test. Furthermore, they "encountered 7 cases in which no change of color followed the lavage. Of these, 5 cases had definite pathological changes associated; obstruction of the cystic duct was the presumable interpretation according to Lyon. Of our 5 cases without color changes in the bile 3 had at operation apparently stones in the cystic duct. In the other 4 cases of the latter series in which no change of color scale occurred no cause was found at operation to explain this phenomenon."

Comment.—Here, too, they confirm my reasoning in explanations of cystic duct obstructions, for they found in 3, or 43 per cent of their 7 cases the failure to recover "B" bile was definitely due to cystic duct obstruction by impacted stones, that in 2 of the 7 cases, or nearly 29 per cent, other definite pathological changes were found associated, but they do not mention what they were, whether there were adhesions, or whether the gall-bladder was small, shrunk and obviously functionless, nor did they give any evidence to disprove the possibility that the cystic duct was mechanically obstructed by catarrh or inflammatory edema, which is a condition not lending itself to easy proof by the usual surgical observation. In regard to the 2 cases which showed no pathological change, these cases might quite as well fall into the group of gall-bladder *atonies*, without visible surgical pathology, from which I have shown that gall-bladder bile is not always recovered. In this connection, too, we must consider the importance of a "physiological block" in the cystic duct or gall-bladder, due to a disturbed nervous mechanism as recently suggested by Smithies.* (See page 438.)

Therefore, these observers have very largely substantiated my contentions by their own work. Furthermore, by the absence of the usual sequence of color changes, due to their inability to recover gall-bladder bile for the reasons they themselves have shown, they have added another bit of evidence that the dark colored bile is derivable from the gall-bladder and not from the liver, unless there be stasis within the liver due to biliary congestion or biliary cirrhosis.

Crohn again questions the origin of "B" bile because in 38 of their cases with recoverable dark bile the gall-bladder and ducts were pronounced normal at operation.

* Jour. Am. Med. Assn., December 24, 1921, No. 26, vol. 77.

It must always be remembered, however, that there are certain pathological findings, recognizable only in the *microscopy* of pathological dark biles, which do not give rise to pathological changes in early stages in the gall-bladder and ducts, which can be detected by surgical sight or touch. No surgeon can tell what is inside the gall-bladder (with the exception of stones) by looking at its walls, and there is common enough evidence to show that such supposedly normal gall-bladders are truly catarrhal or infected as their subsequent return to the surgeon for operative removal would indicate.

As a further illustration. Pus and inflammatory or crystalline evidence is found microscopically in a patient's urine. Cystoscopy and ureteral catheterization shows that it is coming through the ureter, presumably from the kidney. The surgeon operates. Does he always expect to see the capsule of the kidney or the outer surface of the ureter visually inflamed? By no means. Yet he realizes that there must be localized trouble somewhere in the kidney or ureter, because he has learned by experience to trust a microscopical diagnostic suggestion.

The burden of the diagnosis in such cases must, therefore, rest upon each of us, with our several abilities to detect the pathological alterations found by microscopy.

It is necessary to make only one correction in the interpretation of "B" bile as expressed in Chapter VI, namely, that I no longer feel that the capacity of the gall-bladder can be always accurately indicated by the amount of dark bile recovered, because I have become aware that a relatively small amount of thick, tarry black bile can be diluted and thinned out to a relatively lighter brown-black or green-black bile by dilution with freshly secreted liver bile admixed within the ducts. Because it is evident that a few drops of blood will deeply redden to a lighter shade a glassful of water, or, to use another homely simile, that if a heavy motor oil, such as "600-W," be mixed with "3 in 1" the result is not comparable to either of the ingredients. Just so, when dark viscid gall-bladder bile is mixed with "C" or liver bile and duodenal contents it is not the same in color or viscosity when aspirated through the tube as the bile removed at operation directly from the gall-bladder. Indeed, I have seen the actual mixture taking place through the glass cannula (*i. e.*, a lighter yellow liver bile superimposed upon a heavy and more viscid dark gall-bladder bile) in the duodenal tube in several cases. Thus I believe that Premise IV can be sustained.

Premise V.—Evidence that cytological, chemical and bacteriological examination of this fluid is both possible and feasible and leads to dependable conclusions regarding gall-bladder pathology.

Finally Crohn and his coworkers, as well as Bassler and his associates, attempt to show that in their experience they have not been

able to obtain reliable results from the use of the microscope, the chemical or culture tube, and contend that the margin of diagnostic error is too great for the making of reliable deductions.

Comment.—They do not state their methods of examination. Unless their microscopical examinations are carried out within a very few minutes after the mucopus floccules have been recovered, so rapid, sometimes, is the destruction of these inflammatory elements, presumably from digestion by pancreatic and gastro-duodenal enzymes, that the beautiful cytological pictures so often to be obtained are either completely destroyed or show uninterpretable masses of “shadow” cells. By preference all specimens should be examined promptly, but if this is not practical, the cytological pictures can be preserved for a few hours by the addition of a small amount of 10 per cent formalin. This, however, interferes with chemical studies. Crohn admits that he did nothing with the bacteriological side of the question. I assume that Bassler has done more, although he did not state his technic. I would suggest that for confirmation of my bacteriological observations they would follow the method outlined in Chapter XIX, and, furthermore, should take into consideration the corroboratory findings of Brown, Smithies, Sidney Simon and Lanford, Friedenwald, Morrison and Charles E. Simon, Whipple and others.

I have repeatedly proved the identical cytological evidence as found from aspirated gall-bladder samples, and from a biliary fistula and those obtained from the duodenal tube in the same patient, and have repeatedly demonstrated the ability to recover the same bacterial organisms in pure culture in numerous cases from both the operated gall-bladder, the postoperative biliary fistula and from the duodenal drainages. In this connection Charles E. Simon says (in his bacteriological discussion of Friedenwald's paper): “Whatever the therapeutic value of non-surgical drainage of the gall-bladder may ultimately prove to be, so much is certain, that as a method of diagnosis the bacteriological study of the bile has already assumed a position which must rank as equal in importance with other standard methods of examination. No search for foci of infection can hereafter be regarded as complete which does not include an examination of the bile.” He later states in support of its reliability that: “Of especial interest was one case, an old gall-bladder infection, in which *Bacillus subtilis* was encountered again and again as the only organism which developed on the blood agar plates. At operation the same organism, unaccompanied by any others, was cultured directly from the gall-bladder. Following the removal of the gall-bladder the bile was found to be sterile on subsequent occasions.” This case is not unlike Case I reported on page 501.

It is perfectly understandable, however, that in certain other cases, in which pus, desquamated epithelial cells, bacteria and inflammatory débris are found in the first part of the "B" bile, that the gall-bladder contents at operation may be sterile and free of abnormal cytology. As has been pointed out, old chronically diseased and once infected gall-bladders have been found at operation to be frequently sterile. But this may not be true of the ducts, and infection localized to the cystic and common ducts is frequently responsible for the positive cytological findings when these tubes are flushed out by the discharging gall-bladder. It is this residual infection in the ducts that has been the greatest stumbling block of the surgeon and has led to operation and reoperations for gall-stone disease. (8)

Crohn finally questions the significance of cholesterol crystals found in the bile. I believe that the precipitation of cholesterol or other bile crystals *in vivo*, and when found in specimens of bile freshly delivered and freshly examined is of great diagnostic significance, suggesting a calculus or precalculus forming status, although not necessarily pathognomonic of stones; but I also believe that the precipitation of crystals *in vitro* "in the icebox," as mentioned by Crohn, is not a proper method of determining the diagnosis, and is beside the case.

As this question appeals to me, the *formation of calculi* is dependent upon at least four factors (recorded here not necessarily in the order of their appearance): (1) The precipitation from the bile of substances which should be normally held in solution. These are cholesterol, bile pigments and calcium salts, and possibly other substances, such as leucin, lecithin, tyrosin and amorphous salts. (2) Stasis of bile, most commonly taking place within the gall-bladder, but which may also take place within the ducts, and even within the liver lobules. (3) A catarrhal process in the lining membrane of the gall-bladder or ducts provocative to the formation of mucin. These three factors are, doubtless, present either singly or combined at some stage of the initial formation of gall-stones. When to these three factors is added infection, the formation of gall-stones may be greatly accelerated, although infection may in certain cases be the first stage of the entire process, and by producing catarrhal states of the gall-bladder or ducts, may hasten the development of one or the other of the remaining factors. Therefore, the finding of cholesterol or other precipitated crystals, in the absence of one or more of the other factors, does not necessarily mean stone formation *has* taken place.

It is also evident from a study of gall-stones that the formation of most stones is not a continuous process, since the stones are very frequently found impure and are lamellated. The lamellæ have

definite chemical compositions, and in this respect the development of gall-stones resembles the growth of a pearl. It is possible, then, that if the bile be examined in an interval stage between the laying down of two lamellæ no crystals will be found, although stones may actually be present. The presence or absence of crystals then is not in itself sufficient to prove or disprove the presence of gall-stones, but when found and taken as a single bit of evidence, and weighed with the other findings, may be of very definite diagnostic value.

Much more work must be done on the physiological chemistry of the bile. The crystalline supersaturation of biles in connection with certain diseases such as cholesterol in pregnancy may bear close relationship to fundamental conditions of basic metabolism. We must now strive to prove whether this precipitation of crystals is due primarily to their being thrown out from a hyperstatic concentrated bile within a diseased or functionally inhibited gall-bladder or ducts alone, or whether the inability to hold these crystals in solution may not go back to inherent defects in damaged liver cells which are no longer capable of secreting a normal bile.

Therefore, I contend that in the foregoing answer to Crohn's criticisms I have shown that he has unwittingly sustained each of the five premises upon which the fundamental principles of this method must rest.

Now I wish to turn my attention to the criticism of Bassler, Luckett, and Lutz, (4) and see how it should be answered. They attack the fundamental principles of the method at its most vital point, namely, that from a review of my writings when examined in the light of their own experiences they assert that I have failed to present conclusive evidence that it is possible to drain the gall-bladder, "even partially," as Bassler insists, after the use of magnesium sulphate applied to the duodenal mucosa. And in Bassler's paper he proceeds to analyze the five fundamental reasons which I advanced for my belief that the dark bile obtained after magnesium sulphate is derived from the gall-bladder, with the exceptions as I have stated above in connection with dilatation of the ducts and biliary cirrhosis, each of which may and do produce stasis within the excretory channels, and therefore in such cases an abnormally dark bile similar to that stored within the gall-bladder may be obtained.

"1. Because I believe that Meltzer's law of contrary innervation as applied to the biliary apparatus is a correct one, and is based upon a sensible interpretation of the most probable mechanism of the physiological storage and discharge of bile." (Lyon.)

Bassler in attacking this first of my five fundamental reasons then proceeds to quote 10 operative cases which were examined with the duodenal tube *in situ*, 4 under his personal observation and 6 contributed by Luckett, and in his 4 personal cases says that, "In no

instance was it possible to prove any vermicular action on the part of the gall-bladder or any visible reason to suggest that any contraction took place, or that the characteristic dark colored bile when obtained was from the gall-bladder."

Comment.—From what I have said earlier in regard to anesthesia and injury, it must become apparent that I have not only shown the error of their reasoning, but have made it evident that by these very experiments they substantiate my contention, for, although in 4 of the 6 cases cited by Luckett some dark bile was obtained due to an abortive effort of the gall-bladder to evacuate its contents, it was not until after manually pressing the gall-bladder that the darkest bile was secured.

Furthermore, in the light of what I have previously said in regard to anesthesia and possibly surgical trauma acting as agents which would tend to either completely abolish or obtund the normal physiological reflex action of the unstriated muscle of the gall-bladder, why should Bassler *expect* to see any vermicular action or any visible reason to suggest that the gall-bladder was attempting to contract. I fully admit that we have as yet no definite evidence (except Sachs' case) as to by what method the gall-bladder normally empties its contents, whether it be by vermicular movement or by visible peristaltic wave activities or whether it be by simple collapse as Meltzer conceived would take place when the duct sphincter had been relaxed and bile would be discharging under its normal pressure of something above 300 to 600 mm. of water pressure. Presumably there must be a certain *vis a tergo* acting within the ducts, theoretically represented on the one hand by a contractile power in the gall-bladder and on the other hand by various degrees of velocity (or force) of liver excretion.

Bassler's contention that this inability to visualize any movement taking place in a gall-bladder so obtunded by anesthesia must be reconciled with the case report of Sachs and Simanek, (43) and their one or more additional observations. There is no reason whatsoever to doubt the reliability of their observations and it is quite conceivable, as I have already stated, that the visible collapse of the gall-bladder ("like that of a balloon when the air is released"), was due to the fact that in their individual cases the neural strength was sufficient to resist the anesthetic dose.

In further attacking my first fundamental reason Bassler goes on to say that "It is a well known fact that with the identical technic in the same individual various findings as to different colored biles are obtained at different times." I admit that this is a perfectly true statement, but Bassler then says: "Also Lyon draws his simile in the action of the gall-bladder with the urinary bladder. It must be remembered that the control in the urinary bladder is entirely voluntary, while that in the gall-bladder is involuntary."

This, too, is also correct, but I should like to ask Bassler *why* he would always expect that bile, identical in its color and other physical, chemical and microscopical features should *always be the same* when delivered from the same individual any more than he would expect that the urine delivered from the same urinary bladder must always be of the same color, specific gravity and have no variations in its chemical composition. Such a point of view, on the face of it, is perfectly absurd, and is very far from our present knowledge of normal physiological phenomena. Certainly the urine changes in its color and composition from day to day, often from hour to hour, depending upon the fluid intake, the composition of the foods, as well as due to the nervous mechanism itself, such as will produce a light, straw colored urine of low specific gravity so frequently excreted from a nervous, sedentary brain worker at the end of an intensive morning's work. Is it not equally conceivable that such variations may also apply to gall-bladder bile, and may depend upon the duration of its storage, the length of time it has had to concentrate, the volume of lighter liver bile which it receives, perhaps the color of the latter depending likewise upon the chemistry of the food and liquid intake and certain nervous influences which may affect the liver cells and alter the character of their secretions?

A little later on Bassler says: "We are rather of the belief that the gall-bladder acts as a buffer or pressure valve to relieve acute distention and protect the pancreatic tissue rather than that its primary function is that of a reservoir of bile for intestinal digestion. This belief is also fortified in that, while the human may live without a gall-bladder, Nature dilates the ducts after its removal to compensate for this function of the channel system, and until this takes place bile flows more steadily into the duodenum. We therefore believe that there is no evidence to substantiate the belief that installation of a 25 or a 33 per cent solution of magnesium sulphate into the duodenum causes relaxation of the Oddi sphincter or that any contraction of the gall-bladder or emptying (even partially) takes place, and therefore the assumption of Meltzer's and Lyon's reasoning seems to be vitiated."

Comment.—By admitting that the gall-bladder acts as a buffer Bassler ascribes a definite and important function to the gall-bladder which should teach us not to routinely remove the gall-bladder unless there is surgically good and sufficient reason for so doing. I agree with Bassler that the gall-bladder does act as a buffer and believe such action is due to its concentrating ability to take care of the excess amounts of liver bile which it must receive when the sphincteric excretory control is in a state of contraction. As I have stated above, Rous and McMaster (42) have demonstrated this power of concentration and further state that in the normal range of

its function, the gall-bladder can receive 1 quart of liver bile and concentrate it down to a little over 3 ounces, thus preventing undue distention. When the gall-bladder is ablated the ducts try, as Bassler admits, to assume this function by dilating.

When Bassler assumes that this buffer action is designed alone to protect pancreatic tissue he presents only an additional theory without furnishing any proof. This may be one element of gall-bladder function (I shall not attempt to argue it), but I have theoretically assumed with much more practical evidence of proof, that another important function of the gall-bladder is to deliver quickly into the duodenum, when needed for digestion of food, a tenfold concentrated amount of liver bile which can be delivered within a few seconds. Therefore I see no proof advanced by Bassler that Meltzer's reasoning or my own has been vitiated.

In attacking my second reason, which lies in the fact that the color and viscosity of this second bile indicates a higher concentration and strongly suggests its coming from its storage chamber within the gall-bladder, Bassler insists that "this is a very difficult matter to prove in 'B' biles, the specific gravity of which is so changed (elevated) by the magnesium sulphate content, that specific gravity estimations are quite worthless."

Comment.—On this particular point I quite agree with Bassler. Nevertheless, as stated in my answer to Einhorn, I find that testing out the specific gravity in the several biles before stimulation with magnesium sulphate that the darker colored biles usually have a heavier specific gravity than the lighter ones and that the normal range of specific gravity of the darker biles I have found to fall between 1.013 and 1.040. Furthermore, you do not have to depend simply on specific gravity readings to determine the viscosity of the bile. This can be determined, somewhat inaccurately, of course, by shaking the bottle and getting some evidence of its limpidity or its fluidity, just as we can roughly estimate the varying viscosity of several bottles of oil or syrup by shaking them.

Bassler then goes on to say that, "It is not possible to differentiate mucopurulent flakes, pus cells and inflammatory debris, particularly bacteria, as to what part of the biliary tract they come."

Comment.—I ascribe this to either a faulty technic on Bassler's part or to a lack of personal experience in examining such cytology in the light of the comparative histology of the tract. I have partially answered this criticism of Bassler's in one of my earlier replies to Crohn.

A little later Bassler in support of his contention that the darker bile is derivable from the liver and not from the gall-bladder, states that, "From our observations and experiments, then, it is suggested to us that the change of color is due to an oxidation process in which

ferments or constituents contained in the bile cause the conversion of color, this dark bile coming directly from the liver substance as well as being caused by residence in the ducts or gall-bladder when ordinary bile low in oxydase naturally would deepen in color." Bassler and his associates then quote Dunn and Connell's (10) case of hepatoduodenostomy in which the A, B, C, bile sequence was obtained in the absence of the gall-bladder and common ducts. This I have admitted might be true in such a case, and have explained it on the grounds of bile stasis within the liver.

Comment.—I maintain that in stating their opinion that the "change of color is due to an oxidation process" that again they are simply exchanging one theory for another, and furnishing no proof. And, furthermore, they are not accounting for Luckett's findings, or those of my own and others, that under surgical observations the deepest color bile is recovered from the gall-bladder itself after manually expressing its contents, which I maintain goes much further to support my theory than theirs.

Therefore I contend that Bassler has not shaken the validity of my second fundamental reason.

"My third reason for believing that this second bile is derived largely from the gall-bladder lies in the fact that unless we account for it as gall-bladder bile we must account for the presence of from 1 to (in certain cases) nearly 6 ounces of this darker colored and more concentrated bile as coming from somewhere between the common duct sphincter and the secreting cells of the liver." (Lyon.)

In attacking this reason Bassler quotes Einhorn's papers (11) containing his experiments showing that various inorganic salts other than magnesium sulphate will stimulate a quick response of bile secretion into the duodenum, and that Stepp recommended that Witte's peptone be substituted for magnesium sulphate. Incidentally, in this latter connection, you will find that in my paper of October, 1920, submitted for publication several months earlier, I said, "Similarly, the group of antispasmodics, atropine, belladonna and benzyl benzoate, can be investigated, as well as the effect of Witte's peptone or of egg albumen subjected to preliminary artificial digestion, and of various meat extracts and extractives." This I state simply as a matter of record, but it is of absolutely no importance, for Okada (38) in 1914 demonstrated the stimulating effect of peptone solutions on bile secretion by washing the duodenum with this substance.

Bassler then goes on to state his personal experiments with the use of solutions of hydrochloric acid, and says that, "In fact our experience lately has been that for uniformly obtaining the characteristic 'B' bile the installation of from 5 to 50 cc of a 0.5 per cent solution of hydrochloric acid is a far better procedure than the use of

magnesium sulphate solution. These facts, therefore, refute the specific action of magnesium sulphate relaxing the sphincter at the papilla of Vater or influencing favorably the innervation of the gall-bladder, because it stands as irrefutable reasoning that if any one of a number of substances produces the same result as quickly and sometimes more abundantly than magnesium sulphate, Lyon's third reasoning fails to be convincing. It disproves the belief of Lyon that 'six ounces' as a large quantity must come from the biliary channel as erroneous."

Comment.—I have shown in my answer to Einhorn's criticism that both Einhorn and Bassler are in error when they say that the *same* result follows the use of these other substances as compared with magnesium sulphate. I unequivocally challenge this statement. Certain of these substances, notably peptone and hydrochloric acid, will produce drainage results more similar to that which follows the use of magnesium sulphate, but by no means so effective in the long run of cases. An occasional case may be met with, no doubt, in which a fairly good drainage of the gall-bladder can be accomplished by either of these two substances, but it is to be remembered that solutions of peptone may represent the normal physiological stimulus to gall-bladder evacuation, and that hydrochloric acid as partly representative of the gastric juice may alone produce some evacuation of gall-bladder bile although its action will be greatly enhanced if it has first acted upon proteins to convert them into peptones. Pharmacologically, the medicinal use of nitrohydrochloric acid has been long known and quite favorably known as a drug possessing a cholagogic action, but it, as well as hydrochloric acid, acts chiefly to stimulate a flow of bile from the liver through the hormonal influence of secretin converted from prosecretion by the hydrochloric acid. I maintain that while hydrochloric acid may perhaps act better as a hepatic secretagogue than does magnesium sulphate and perhaps may deliver a larger expression of liver bile, it does not lend itself so well to evacuating the gall-bladder. I therefore maintain that neither Bassler, nor any one else, has thus far brought forth any theory or experiment to invalidate my third fundamental reason.

In closing his attack on this third premise of mine, Bassler concludes his arguments by saying, "We therefore believe that if the obtaining of bile in quantities is an important point in a therapeutic way, and this bile possesses all the characteristics of that obtained from an installation of magnesium sulphate solution, the use of a weak solution of hydrochloric acid is a far better means to obtain a large quantity than magnesium sulphate."

Comment.—As I have stated above, this bile does not possess all of the characteristics of that obtained from an instillation of mag-

nesium sulphate solution. In fact, quite the contrary. Furthermore, in regard to the use of hydrochloric acid for this purpose, it appears to have escaped Bassler's attention that seven years previously Okada (38) found that the same abundant flow of bile followed lavage of the duodenal mucosa with dilute hydrochloric acid.

"4. My fourth reason, and I feel it is the strongest, for believing that this second type of darker yellow and more viscid bile is actually coming in large part from the gall-bladder, lies in this (I think) convincing fact—namely, that in the cholecystectomized patients that I have studied postoperatively some ten or more cases.* I find (a) that I never recover the second type of dark bile but pass immediately from the light golden-yellow or relatively more concentrated common duct bile to the light lemon-yellow and limpid bile that I believe is freshly secreted liver bile and collectable for long periods as rapidly as it is secreted, and (b), I find that (in this cholecystectomized group) in the larger number of instances, bile is continuously entering the duodenum in the fasting stomach and duodenal state, indicating that the duct sphincter is in a state of inhibited tonus, probably permanently so, since the antagonistic or contrary innervation has been cut when the gall-bladder was removed." (Lyon.)

In quoting my fourth reason I beg to call attention to the fact that Bassler, whether intentionally or otherwise, has failed to quote it correctly by omitting reference to a foot note over the word "bile" in the sentence reading, "I never recover the second type of dark bile" (in cholecystectomized patients). By referring to this footnote, it will be found to read as follows: "It is conceivable that in cases in which the gall-bladder has been removed and in which the ducts remain infected and the common duct becomes secondarily obstructed, that in such cases dark inspissated or static bile may be recoverable."

Bassler then attacks this reason by stating that, "Characteristic 'B' biles are not only obtained from the vast majority of cholecystectomized individuals, but also from those not yet out of bed from the operation before the ducts have had a chance to dilate to take up a gall-bladder function."

Comment.—I challenge this statement that the vast majority of cholecystectomized patients will deliver the typical "B" bile seen in the average non-cholecystectomized patient. In my experience it has been the exceptional case which shows this and, as I have stated above, occurs most commonly in such cases as present clinical or operative evidence of dilatation or partial obstruction within the

* Since the publication of this paper in 1920 the series of cholecystectomized cases postoperatively studied now exceeds seventy.

common duct which leads to damming up of static bile within the liver, as occurs in various grades of biliary congestion or cirrhosis.

That Bassler has observed the recovery of darker colored biles from such operated cases when tested one or more weeks after their operation, or before sufficient time had elapsed to conceivably cause duct dilatation, I admit is a true statement, for I have seen it myself. But there are two reasons to account for this. One is in the well known fact that in observing the bile being drained from the surgical drainage tube of the operated patient, whether from a cholecystostomy or choledochostomy, we see for the first few days, to a week or even longer, that the bile being drained is of a darker color persisting sometimes even after the discoloration caused by blood admixture within the bile as an immediate result of surgery. This dark colored bile may be a reaction on the part of the liver as a result of the toxic effects of the anesthetic, just as the scantier postoperative urines show a higher color due to increased concentration. After this toxic effect wears off the bile coloring will gradually lighten and approximate more the normal color of liver bile. Secondly, in many of the operative cases so cholecystectomized the patient is very frequently in a state of jaundice, which, of itself, indicates biliary obstruction with stasis within the liver lobules and therefore the dark bile, as I have already contended, could be coming from this source.

Finally, in this paragraph Bassler mentions the fact that in cases of achylia gastrica a better gall-bladder evacuation is obtained from the use of hydrochloric acid than from magnesium sulphate. I also challenge this statement, for I have found that some of the deepest, blackest biles that I have seen recoverable with magnesium sulphate have occurred in cases of achylia gastrica. This is, of course, natural, since the physiological duodeno-gall-tract stimulation is lacking in such cases due to the absence of this hydrochloric acid.

Therefore I maintain that Bassler has failed to successfully sustain his attack on my fourth fundamental reason.

"5. I might add a fifth reason, to the effect that in my post-operative group of cholecystectomized patients upon whom this non-surgical method has been practised (because the length of time over which surgical drainage could be maintained has not been sufficient to allay the catarrhal inflammation or to arrest the infection), that is in this group, together with a group of non-operated patients with cholecystitis or with gall-bladder biliary stasis, I have seen this second type bile, easily demonstrable as pathological, gradually clear up and return to a more normal appearance under bi-weekly drainage by this method." (Lyon.)

Bassler naively states that, "This, it occurs to us, is entirely a happy assumption and will remain so until it is proved that the

so-called 'B' bile is derived from the gall-bladder, which in our belief has not been done."

Comment.—This observation requires no further substantiation beyond what I have already given, but at this point I might say that both Bassler's concluding pages, as well as the concluding paragraphs of Crohn, which deal with their failure to obtain therapeutic results from this method, is, I believe, due to several factors; possibly a faulty therapeutic plan of management as regards the frequency and total number of drainages required in any individual case; perhaps an injudicious selection of the type of patients which this method can unquestionably help, and, in many cases, apparently cure; and to a failure to comprehensively ascertain all factors which enter into the patient's general conditions of ill health and consequent failure to make the treatment comprehensive enough to control the collateral or contributory states of dysfunction or disease. Both of these critics have been woefully lacking in their bacteriological study of their cases, and in their failure to make use of the help to be obtained by autogenous vaccines.

Before I turn finally to a review of Bassler's conclusions, I would like to take up just a moment longer in supporting my contention that this method of using magnesium sulphate as first suggested by Meltzer does serve to evacuate the gall-bladder, partly or wholly, of its fluid contents and in certain instances of its solid concretions, by asking my critics the following questions:

If "B" bile, with the exceptions to which I have alluded, is not being derived from the gall-bladder, how else can we so well account for our recovery of small gall-stones or gall-sand directly through the tube, or our recovery of larger gall-stones found in the sieved stool of patients who have recently had a duodenobiliary drainage? Are they all coming from the ducts or liver? How else can the recovery of large quantities of practically pure pus in several of our proved cases of operated empyema of the gall-bladder be accounted for? Is it all coming from the ducts or liver? How else can the reproduction of gall-bladder pain, either of a definite colic type, or a sense of upper right quadrant soreness or of infrascapular pain following certain of our drainages in cases with definitely inflamed, infected or lithic gall-bladder be so well accounted for? How else can we account for the recovery of identical microscopical cystology in our presumptive gall-bladder specimens of bile with that recovered directly from the gall-bladder at operation or by direct aspiration of bile through persistent biliary fistulæ in certain sinus cases in which repeated opportunities have been offered to check up on this point? How else can we account for the non-operative relief of cases of acute typhoid cholecystitis, or for not only the symptomatic recovery often brilliant, if not of actual cure, of a very

large series of patients after a course of medical biliary drainage, but also for the coincident improvement in, or the final disappearance of, the pathological microscopical and cultural findings in such patients? Finally, I should like to ask Einhorn and Bassler that if they contend that the dark colored bile is derivable from the liver and not from the gall-bladder why is it that they (or I) do not obtain it in *all* cases and especially with those solutions that are hepatic secretagogues rather than gall-bladder evacuants?

I should like to be permitted again to point out that this method is not and was never intended to be a cure-all for all types of gall-tract disease. It has limitations as to the selection of cases in which it should be used, and I find that primarily these patients fall into a fundamental first group of gall-bladder disease in whom we must prove by a diagnostic drainage that we can secure the deep colored bile resident within the gall-bladder and not due to other states within the ducts or liver, in other words that we can actually drain the gall-bladder as well as the liver and the ducts.

Having made this fundamental classification of this group, the cases to be treated by this method may include the states of early gall-bladder catarrh or infection, and the states of atony, and indeed certain states of well advanced pathology, but which occur in patients who show marked surgical contraindications in liver, kidney or other vital systems and in whom this method can then be practised as an alternative plan, as a temporary procedure with the hope to so reduce the toxemia as to make later operation a safer procedure; and finally, as a follow-up postsurgical measure to continue to medically drain the residual infection left in the ducts or liver, a state which so frequently occurs after a cholecystectomy has been performed.

A very detailed discussion of the cases which should and should not be selected for treatment will be found in Chapter XXIII.

There remains nothing further for me to discuss in Bassler's paper except the conclusions which he has drawn. Under ordinary circumstances I would not care to criticise any one's conclusions, especially when they are based upon such a carefully prepared study as Bassler and his associates have presented. But I feel that the occasion warrants it, inasmuch as they have attacked so vigorously each of the underlying fundamental conceptions upon which the method of medical drainage of the gall-tract is based. Nor would I necessarily do so even then were it not for the fact that I most heartily and earnestly believe not only in the soundness of the principles of this method but also believe that it possesses so much usefulness in the detection of and in the alleviation of, if not in the cure, of gall-tract disease, that I feel that a responsibility more than ever rests upon me to defend its value. I will append Bassler's nine conclusions with brief comments on each.

"1. The assumption of Meltzer of 'the law of contrary innervation' is not proved, and this throws into doubt any specific effect of relaxation of the sphincter of Oddi and contraction of the gall-bladder induced by a magnesium sulphate solution.

Comment.—I concede that in its broad aspects Meltzer's law of contrary innervation is not definitely proved. But it is theoretically so sound and so much better than any other theory that has yet been advanced to explain the probable mechanism of the filling and emptying of the biliary tract that I believe that it will be ultimately proved to be correct. I do deny, however, that Bassler has presented any evidence which could tend to throw doubt upon the specific effect that magnesium sulphate possesses in its power to relax Oddi's sphincter and to cause an evacuation of the contents of the gall-bladder, although I admit that the *exact* manner in which the gall-bladder actually empties itself still remains a matter of speculation.

"2. Any one of many substances taken into the stomach or injected into the duodenum will cause a ready flow of bile, of which a solution of hydrochloric acid in about one-third the acidity of normal gastric juice is the most potent for discharge of bile in large quantities and obtaining characteristic 'B' bile."

Comment.—I admit that any one of the substances mentioned in this paper when injected into the duodenum will cause a ready flow of bile in most cases, but will do so in varying degrees. Some will undoubtedly relax Oddi's sphincter more quickly and more regularly than will others but I deny that any of them, with the exception of magnesium sulphate, olive oil, peptone solutions and solutions of hydrochloric acid has any power to evacuate the contents of the gall-bladder, except in negligible quantities, and that as regards their efficiency in this respect these substances can be placed in the order in which I have named them, and of the four magnesium sulphate is by far the most efficient and reliable chemical to use for this purpose.

"3. That the deeper color of 'B' bile is due to oxidation and not concentration from retention in the gall-bladder, this bile most often coming directly from the liver as a phenomenon of bile secretion."

Comment.—I maintain that this conclusion of Bassler's simply represents the presentation of another theory as to the origin of the deeper colored "B" bile and yet fails to present any supportive proof for this theory. I furthermore contend that he himself, entirely independent of what I have said of my own work, has advanced greater proof of my theory that, with certain very limited exceptions, the deeper colored "B" biles are derivable wholly or in part from the gall-bladder.

"4. That the viscosity of bile does not elevate its specific gravity to any practical extent."

Comment.—I can only affirm that in my studies in regard to the specific gravity of the several biles recovered from the gall-tract, that in the comparatively infrequent exceptions in which we find a true A, B, C sequence without the use of magnesium sulphate or any other chemical or any other stimulant, beside what may be coming from the acid gastric juice delivered from the patient's own stomach, that I find that the specific gravity of the darker colored biles has a higher range than the lighter colored ones; that of the "B" biles which I have studied the specific gravity variation in health and disease varies between 1.013 and 1.040; that apparently the bile is normally an acid fluid; and that the higher degrees of acidity are found in the deeper colored biles.

"5. That the margin of error in deducting from the presence of mucopurulent flakes, pus cells, inflammatory debris, bacteria and cells in the aspirated bile as positively coming from the gall-bladder is too great for clinical deduction."

Comment.—I admit that there is a certain and variable margin of error in making such deductions. I believe, however, that this margin of error must be very similar to that which was asserted shortly after the method of microscopically studying the cytology from specimens of urine was introduced. Nevertheless, as time has gone on much progress has been made in this respect, so that he is a very poorly trained fourth year medical student who is not definitely able to discriminate between vaginal epithelium, urethral epithelium and bladder epithelium and who would make any mistake of interpretation that hyaline, waxy or granular casts are coming from the urethra instead of from the kidney.

So I maintain that if the doctor of today or the medical student of tomorrow will assiduously apply himself to the microscopical study of bile that he will learn to differentiate the usual types of oval or cuboidal duodenal epithelium, usually unbile stained, from the heavily bile stained columnar epithelium from the bile ducts or gall-bladder, and will be able to make certain reliable deductions as to the source of pus cells, various strands of mucus, and even the probable origin of the bacterial evidence (colonies, etc.). I might discuss this at great length, but I will refer you to the more elaborate consideration of this topic to be found on pages 320 to 325.

"6. That the physiology of the gall-bladder should not be deduced from anatomy and relationship alone—that its most important function seems to be to relieve pressure within the biliary system to protect the pancreas rather than acting as a reservoir for bile in a digestive sense, and that the physiology of bile secretion and gall-bladder function should be studied more thoroughly."

Comment.—I am entirely in accord with the first two lines and the last two lines of this conclusion, but I maintain that the balance of it is merely substituting one theory for another without advancing any proof.

“7. That cholecystectomized individuals show the characteristic ‘B’ bile even shortly after operation before the ducts have had a chance to dilate. This occurs so commonly that ‘B’ biles cannot always be from the gall-bladder.”

Comment.—I have admitted the validity of the first sentence, and I admit, too, that “B” biles cannot always (note my exceptions) be from the gall-bladder, but I maintain that from the remarks which I have made above that I have disproved the soundness of this conclusion.

“8. The increase in specific gravity in aspirated bile by this method is due to the content of magnesium sulphate, which appears to be resorbed into the portal circulation and is excreted by the liver substance in the bile. It is erroneous to deduce clinically in both amount of biles obtained of any gradation (A, B, C, D) or by specific gravity estimations as to whether bile stasis exists or not.”

Comment.—I have admitted the validity of the first sentence and have given my reasons both to Einhorn and to Bassler as to why I agree with Bassler that the taking of specific gravity readings does not permit us to make any accurate deductions as to the state of the gall-bladder. I deny, however, that it is erroneous to deduce clinically certain diagnostic inferences as to whether bile stasis exists or not and where it exists.

“9. That where a true pathological condition exists in the gall-bladder the method is a poor substitute for proper surgery. It may be employed in suitable cases as a temporizing means, but it should not be depended upon to correct or definitely benefit pathologically diseased gall-bladders or when gall-stones exist.”

Comment.—I am only in partial agreement with this one and final conclusion of Bassler’s. As I have stated, I have never advanced this method as a “cure-all” for all gall-tract disease nor do I ever expect to see it so developed as to exceed its natural limitations. I do, however, maintain that it is the method of choice for the treatment of early states of gall-bladder catarrh, infection and disturbances of function; that it will be applicable to many truly diseased but early pathological states of the liver and gall-tract *in toto* which are unrecognizable and are passed over by the trained surgical eye and touch, and yet, nevertheless, harbor pathogenic factors which, if not recognized and treated at this stage, will inevitably tend to progress to well developed pathological alterations in gall-bladder, ducts and neighborhood viscera that will later require surgical interference for their correction. I also maintain that it has

already been proved to be an alternative method of treatment for use in cases which show grave surgical contraindications; and, finally, that it is a useful method, and will ultimately be widely adopted in the postsurgical management of cholecystostomized and cholecystectomized patients in order to rid them of residual catarrh or infection in gall-bladder or ducts and thus aid us in preventing the necessity of so frequent reoperations on the gall-tract.*

In conclusion, I may say that so far in an already large and rapidly growing series of cases, many of the patients gravely ill and many of them far from cured after repeated applications of surgical methods, I have seen comparatively few which have not been in a great degree distinctly benefited and many cured by the application of this method and with absolutely no mortality. In this respect alone I predict that the future of this method will become even more brilliantly recognized.

What the ultimate proof or disproof of the validity of the soundness of this method will be, or where it may come from, I dare not hazard a prediction. I would be most extraordinary if any new method, particularly one so revolutionary to modern concepts as is this one, should be ultimately found to be correct in every detail of its original postulates. Nevertheless, I believe that the more thoughtful medical public who will take time to digest this argumentative discussion will agree with me that up to the present the fundamental platform upon which this method rests has not been shaken.

ADDENDA.

I. A very interesting and careful study into the reliability of this procedure as a diagnostic test was made by Cutler and Newton (7) upon patients from the surgical clinic of the Peter Bent Brigham Hospital in Boston, Mass. This paper deserves a full analysis, but was published too late to be included elsewhere in this chapter.

They state that "the test is simple only in description," whereas in reality in regard to its usefulness in diagnosis it is a complicated affair requiring bacteriological, microscopical and roentgen-ray apparatus, and that the test must still be considered as in its experimental stage, and that much remains to be explained before its real value can be accepted.

I cheerfully admit all of this and have realized it as being one of the reasons why I should attempt to set down a more elaborate discussion of the subject.

After citing their experiences in the study of an excellent and large series of cases, well controlled by operation, and after a thoughtful and critical analysis of much of the available literature, they come to the following summary and conclusions.

* See Case Reports, Chapters XXVII to XXXVI.

Summary.—“Interest in this procedure as an aid in both the diagnosis and treatment of biliary conditions has become widespread. Already it has reached the hands of the general practitioner, and in spite of the difficulty of carrying through its correct performance is in actual practice by a large number of doctors. This is exceptional in a profession usually conservative and leads one to think that the many careful studies already reported, which seem to show that the knowledge the test may give is unreliable, are not generally recognized. It is possible also that the strong psychic appeal any such a procedure must awaken in a patient has led doctors as well as patients into a false sense as to the real physical good this manœuvre can give.

“Following the above discussion, it is our opinion that there is much to be proved before the so-called ‘Meltzer-Lyon’ test can be accepted as of value in aiding diagnosis, that it should still be considered as only in an experimental stage, and its use should be discouraged by any except those who are qualified and equipped to study and criticize its value. It is by no means a simple test. Should one grant all that Lyon claims for it, to be exact, it requires roentgen-ray apparatus, much time, repeated examinations in all cases, and elaborate bacteriological and cytological studies. The test depends upon the law of contrary innervation which must be proved before the test is accepted. At the present time the evidence would seem to show that siphonage is the principle factor in the defection of bile into the duodenum. Exactly what determines the intensity of the color of the bile remains a question. In our opinion dark bile comes from the gall-bladder, and this accords with the recent work of Rous and McMasters (42) and Harer, Hargis, and Van Meter (19) on the concentrating ability of the gall-bladder. We have never found real dark bile in cholecystectomized cases. However, the contentions of Einhorn and Meyer (12) that the dark color is due to reëxcretion of the salt or to destruction of red cells in the liver with the production of excess iron or the belief of Bassler, Luckett, and Lutz (4) that such color is due to an increase in the amount of oxidase must bear further study.

“Our own experience has left us with the distinct impression that the test is not of dependable diagnostic aid. With its use in treatment except for a few rare cases we have no experience.

“The lack of unanimity in the results obtained by different investigators is the best proof of the unreliable status of this test at the present time.”

Conclusions.—1. The ‘Meltzer-Lyon’ test is based upon the application of the law of contrary innervation to the biliary system. There is no proof of this at present.

"2. It is our opinion that the specimens of bile obtained are the result of siphonage.

"3. The test cannot be depended upon for diagnostic purposes even when accurately performed."

If one merely read these conclusions it would serve as a sorry recommendation of the method. But if one reads the text of their paper and studies their charts it will be found that *the test has achieved a substantial corroboration at their hands that is not consistent with their abrupt conclusions.*

For instance:

1. They have confirmed my findings in regard to the A, B, C, sequence of a normal drainage, and, to a large extent, my findings in normal control cases.

2. In their series of 14 cases tabulated under the heading of "No B bile obtained" suggesting cystic duct obstruction, in 10 of them (71.4 per cent) they state that "the test diagnosis was substantiated." This is certainly a gratifyingly high percentage. In the remaining 4 cases (28.6 per cent) the explanation for the failure to recover "B" bile will be found in my discussion in Chapter XVIII, p. 330.

3. In their series of 5 cases tabulated "abnormal gall-bladder bile obtained by test" they preoperatively diagnosed cholecystitis or cholelithiasis or both and state that "All cases came to operation where the test findings were substantiated" (100 per cent).

While they further state that "In this group the preoperative diagnosis was made as much on the history as because of the test findings," nevertheless the latter served to confirm the clinical suspicion.

4. In their series of 4 cases tabulated as "very little bile obtained," 3 of the 4 patients had been *jaundiced* for four weeks to five months. Of 2 of these who came to operation 1 had cholelithiasis, pancreatitis and died, with autopsy. The third case (not operated) was found due to postoperative cicatricial stenosis of the bile ducts and died later from hemorrhage from another source. The fourth case (operated) was not severely jaundiced but had carcinoma involving the common bile duct.

Therefore in these 4 cases the diagnostic suggestion was confirmed.

5. In 1 case tabulated as "no bile obtained by test" in a patient deeply jaundiced, the preoperative expectancy was malignancy obstructing the common duct (presumably because of the long history of nausea and vomiting for one and a half years and thirty pounds loss in weight), and yet operation revealed a stone impacted in the ampulla of Vater. Surely the test itself was not at fault in this instance of erroneous diagnosis.

6. In the 3 cases of peptic ulcer studied, 2 returned a normal gall-

bladder test (66 per cent) and in the third one from whom pathological "B" bile was secured, they offer an explanation which might well account for this finding.

Therefore, in thus briefly analyzing the findings as given by these authors, I am somewhat surprised at the conclusions they have drawn.

Reasonable criticism of their failure to make better use of bacteriology and cytology in securing the minutiae of diagnosis is justifiable if one will refer to my discussion of this in Chapters XVIII and XIX.

I do not consider it amiss, and hope my motive will not be misunderstood as a criticism against surgery, to call attention to the fact that of the total number of 25 cases which these authors have tabulated as having been operated on, 5 of them died before they left the hospital (a mortality of 20 per cent, occurring in one of our best surgical clinics). Of the remaining 20 cases who recovered from the operation itself no follow-up note of end results is included.

I would believe that some of these cases might have been saved if the preoperative and postoperative management I am advocating had been employed. (See Chapter XXII and Case Reports.)

II. The interesting experimental studies of Frazer (14) were also published too late to admit of full discussion before this chapter went to press. He made a biliary fistula connecting with the distal end of the common duct of dogs, and transplanted the duodenum to just beneath the skin and fascia, and through the former he ascertained the "normal" flow of bile secreted; and he introduced a solution of magnesium sulphate into the transplanted duodenum and noted its effect in altering the flow of bile or changing its color. Frazer concludes that "The results of our experiments were entirely negative. When magnesium sulphate solution was injected directly into the duodenum of dogs or injected into the circulation, there was neither acceleration of the rate of flow of bile, nor change in the color. In many instances the rate was even somewhat retarded. When bile was injected into the duodenum, there was a definite, prompt increase in the flow of bile."

By many, these experiments will be pointed to as incontrovertible evidence against the fundamental validity of this method. I maintain, nevertheless, that all such experiments as this, while necessary to further the progress of science, fall far short of giving us a true answer. Many of the argumentative reasons expressed in this chapter, as applied to the position taken by Crohn *et al.*, Bassler *et al.*, and Dunn and Connell, apply likewise to these experiments of Frazer.

Taking into consideration the conditions and methods under which they are conducted, you *cannot* compare such experiments on

animals with clinical experiments performed on human beings under conditions which certainly disturb the actual physiology to a much less extent, and expect the results to tally. The experimental worker on animals will say that I do not wish the truth revealed and am merely hiding myself behind a "smoke screen" of words.

But *can* any one logically attempt to adduce "normal physiology" from a dog bound fast to a frame and made as comfortable as possible with a metal cannula stuck in his abdomen, even though, as stated by Frazer, "after a little training the animals lay quiet for many hours at a time," and attempt to compare such data in regard to physiology with a series of patients lying on comfortable beds (albeit with a duodenal tube *in situ*), in pleasant surroundings and with their minds diverted and their nervous systems rested by sleeping, by reading or being read to, by knitting or by listening to music?

No reader need infer that I am in any sense opposed to animal experimentation when properly controlled by the humane spirit now dominating scientific research. I am fully aware of the great contributions to human welfare and health which have resulted from properly conducted animal experimental investigation.

In this book I am not presenting merely a brief for or against magnesium sulphate or any other substance used in the performance of non-surgical biliary tract drainage (although I prefer magnesium sulphate and olive oil as stimulants); nor am I in the narrow sense dogmatically insisting that the gall-bladder empties itself by simple contraction alone or by gravity or siphonage due to a relaxed sphincter, or by combinations of these and other influences (contraction of diaphragm, milking of duodenum, etc.); nor am I insistently arguing that the gall-tract system empties as a result of Meltzer's law of antagonistic innervation alone or as a result of the general law of osmosis in relation to hypertonic solutions. (Knight.) (26)

Rather I am attempting to establish, by a presentation of my views and by case illustration, that non-surgical drainage of the gall-tract is a *practical procedure* and will, within certain limits, to which I call attention, be found useful both in the diagnosis and treatment of certain types of gall-tract and allied disease.

III. The following papers have been published after the manuscript for this book had been delivered to the publishers, and therefore cannot be individually discussed. Certain of the questions raised by those authors have been substantially answered in this chapter. It is of interest to note that Fitz confirms my observation recorded in Chapters III and VII, that bile appears to be an acid rather than an alkaline fluid.

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CHAPTER VIII.

DIAGNOSIS.

THE NECESSARY FACTORS REQUIRED IN THE MAKING OF A DIAGNOSTIC STUDY OF THE GASTRO-INTESTINAL TRACT —GENERAL PRELIMINARY CONSIDERATIONS.

FOR the successful treatment of any disease it is an absolute preliminary requisite that we have a sound diagnostic conception of the disease to be treated. Not only must this diagnosis embrace the one or more *major* functional or pathological states, but any sound diagnostic conception must fundamentally go back in a search for the earliest or primary causative factors which have led up to the production of the major complaint, and furthermore must take cognizance of the several *minor*, collateral or contributing factors which enter into the total picture of the individual patient. These contributing factors serve to modify the course of the major disease, and unless they, as well as the original causative factors, are sought out, recognized and removed, the major disease, although treated with apparent success, will again and again show a tendency to relapse or to reëstablish itself. This statement applies equally pertinently to the surgeon who cuts out and apparently permanently removes the so-called primary or major pathological tissue, but who leaves behind unrecognized residual disease, as well as surgically damaged structures, which become likely points for reinfection or redevelopment of inflammatory states.

I believe that nowhere in the domain of internal medicine do such a multiplicity of conditions present themselves for diagnostic interpretation as in diseases involving the digestive canal and its appendages. The major condition or state of disease may be easily apparent in certain cases to the average doctor who has had an adequate general training. *These are cases in which the diagnosis can be made almost by the history alone.* For instance, a massive fresh hemorrhage from the stomach in a chlorotic young woman will suggest a phagedenic gastric ulcer; a sudden melanic hemorrhage from the bowel in a young male adult who has been complaining of one to three hour postmeal pain and sense of hunger contractions, accompanied by pylorospasm or pyrosis and relieved by further ingestion of food or by baking soda or other simple alkaline powders or tablets, will at least suggest a duodenal ulcer.

Surely a *bona fide* attack of gall-stone colic, especially when associated with jaundice produced by an impacted common duct stone, and followed by clay-colored stools and a dark reddish-brown smoky-colored urine, is clear enough in its general aspects for any doctor to make a fairly accurate major diagnosis. Again a sudden attack of diffuse abdominal cramps in a young adult, soon followed by nausea and vomiting, with a tendency to gradual centralization of the pain in the right iliac fossa, with involuntary rigidity and spasm of the lower half of the right rectus muscle and localized tenderness over McBurney's point, is a picture so indicative of acute appendicitis that scarcely any doctor of today would fail to give such a symptom grouping first consideration. Or again, a patient who presents a history of left lower quadrant pain, with tenesmic gripings preceding defecation, and who later may show symptoms of rectal or anal spasm with sometimes excruciating pain during the passage of a stool, accompanied by or followed by more or less copious bright red bleeding, may, without difficulty, be strongly suspected of having sigmoiditis with a spastic lower segment, a rectal or anal fissure, and either a polyp or engorged and ruptured hemorrhoidal veins.

Surely the *major* diagnosis in all such cases are easy to make, but even in these cases much too little time is spent in the determination of the primary causation of the major disease. What were the factors which entered into the production of the gastric or the duodenal ulcer, the development of gall-stones or gall-tract inflammations? What led up to the inflammatory state of the appendix and what produced the inflammation in the sigmoid colon, and by what process of preceding factors have the rectal fissures or the hemorrhoids developed?

We must train ourselves to go back over the trail and pick up the primary causal agents which produced the major complaints or states of disease. Until we learn to do this, and by so doing secure an adequate appreciation of the necessity of rooting out and destroying these primary causative factors, much of our efforts directed to the so-called cure of the major disease will be wasted, and we will see relapses or the development of postmedical or postsurgical sequelæ. Thus diagnosis of today in regard to the digestive tract must be systematically planned, wide searching in its total compass, and must sooner or later be made to take stock of all associated vital system groups of the body.

If adequate diagnosis is required to work out the beginning details of the comparatively easy diagnostic illustrations cited above, how much more difficult does differential diagnosis become when we find ourselves dealing with relatively *vague* pictures of *chronic* digestive disorders which have not progressed to the classical syndromes or

clear cut clinical entities? These are the days when we are beginning to realize the importance and value of making complete diagnostic surveys of all patients, but particularly those presenting long continued symptoms of chronic ill health. And no diagnostic survey is complete without a most careful study of the gastro-intestinal tract, and not alone by means of the roentgen ray or simple test meal analysis. The cause of much chronic invalidism will be found to lie here.

To be successful in such diagnostic work requires many years of patient preparation. It is not every doctor who is by Nature suited to such a field. The really great diagnosticians must have an element of the detective in their make-up if they are to successfully track down and eradicate the malevolent agents of disease. They should have a love for the investigative side of medicine. Their foundations must be securely laid. Their fundamental preliminary education must be sound. They should have devoted a certain period to acquiring a familiarity, or, better still, a mastery, of the premedical sciences of biology, physics and chemistry, secured preferably by a college curriculum. Their medical school should be wisely chosen for its ability to give them a sound training in embryology, anatomy, histology, physiology, physiological chemistry, bacteriology and pathology, under the guidance of teachers who can inspire enthusiasm for these drier subjects. Such a school should have made provision for the maintenance of experimental laboratories in all of the major subjects. Its teaching hospitals should have adequate dispensary services and clinical laboratories and its system of teaching in the hospital wards and amphitheaters should be properly correlated and should be presided over by men who not only know how to teach their subject, but who have the ability to inspire the student with the art of acquiring knowledge and to inculcate a desire for investigative research.

Having graduated from such a school, the hospital internship, preferably of longer than one year, should be passed in an institution which provides for a rotating service, which starts with the laboratory, advances into the out-patient service, passes thence to the medical division, and winds up with a surgical service. A hospital service so arranged often attracts the better type men, since it provides a broader postgraduate medical education than do the hospital services which are too short or are restricted to a single specialistic division. It is comparatively rare, I believe, that a young doctor knows from these early beginnings of his medical life just what special field he may wish to elect. It is far better to train himself at this stage to become a practical and efficient general practitioner, rather than thrust too soon into any specialistic group.

Having completed this minimum of theoretical and practical work

required by law, it is the wise doctor, and usually the fortunate one, who will devote the next year or two to continuing his studies by giving his services to out-patient dispensaries before launching too far into practice, and, perhaps above all things, he should secure work in the pathological laboratory of a busy hospital. Lucky is the man who receives such a laboratory appointment, and particularly he who later can help in directing the special investigative lines of its work, in addition to covering the routine examinations. Access to dead house material and opportunities for postmortem anatomical dissections and dead pathology is of the most vital importance in laying the groundwork for a subsequent understanding of many clinical features of disease.

So, too, gross and microscopical pathology obtained from surgical or postmortem material is invaluable. Special time devoted to bacteriology, serology and blood chemistry will render a later return in knowledge and in its practical application in clinical medicine that cannot be overestimated. Laboratory knowledge *personally* acquired can never be taken from you, even though the scope of laboratory work is forever enlarging and developing, for a knowledge of the fundamental principles of how to go to work on a laboratory problem is gained by these earlier years of hard application. During this period of a year or two many a doctor, unless possessed of independent means, is hard put to keep from physical starvation, although mentally well-fed.

From the laboratory and out-patient services the next step is to secure if possible a house attending position in a good hospital. By now practice is developing, and by means of this a summer or two may be spent in European study or in visits to our better American teaching centers. After this period of three to five years during which we continue our medical studies beyond those required by law one has usually settled upon what particular part of the total field one wishes to familiarize as a specialty, and thenceforth a greater amount of time can be given to acquiring a mastery of this subject.

So much of this preliminary work is not absolutely required if one enters a specialistic field such as the eye, the ear, the nose or throat, roentgenology, dermatology, urology, electrotherapeutics, orthopedics, obstetrics, or possibly neurology. One may perhaps enter these fields at an earlier date, and the plan of preparation may be less comprehensive. However, when one is considering entering the broad field of gastro-enterology, which cannot and should not be practised as an individual specialty, since it is so closely and intimately related to nearly every branch of clinical medicine, and especially concerned in the solving of its problems, I maintain that too great care cannot be spent upon the preliminary preparation

for this field. An intimate knowledge of gastro-enterology is of vital importance in a well rounded knowledge of clinical medicine, and its diagnostic problems. Lack of knowledge in this particular department frequently proves the chief stumbling block to an otherwise able clinician, while the average doctor appears to be totally unable to successfully manage anything but the simple gastro-intestinal upsets.

If we are to learn the secrets of the earliest beginnings of the life history of the later well developed gastro-intestinal pathological entities we must develop a practical method of ascertaining and fundamentally correcting these early beginnings of either functional or organic disturbance or disease, and not sit by supinely pinning our faith to the oral administration of many useless drugs, to the arrangement of impractical and unscientific dietaries which do little more than temporarily quiet the symptomatic picture in the more successful cases, and still allow the usually infective causative factor to insidiously develop its train of pathology into the later full-blown and then easily recognized pathological syndromes. *Chemical therapy haphazardly applied has had its day in the management of gastro-intestinal disease.* We must learn to get away from uselessly drugging our patients, and acquire a better mastery of technically and topically treating them.

To become eligible to enter the broad field of general diagnosis, it is obvious from what has been said above that a proper training period should have been passed through. Even having covered this same groundwork all diagnosticians do not acquire the same ability. The truly exceptional diagnostician who stands apart from his fellows, in addition to his generally sound knowledge, and possessed of a personality suited to his calling, usually has a high sense of intuition and an intangible something not possessed by all. He will assemble his diagnostic facts and be able to fit them together to the development of a more perfect and correct final diagnostic picture.

Much has been said recently in criticism of the tendency in medicine of today to develop diagnosis by means of endless charts, curves, graphs and laboratory formulæ, and to sit back and admire such handiwork, perhaps at the expense of failure to make skilful use of the five senses employed to such advantage by our medical forefathers. Certainly neither one of these extremes is alone correct. They should be wisely combined, each with a consideration of what can be gained by the other, but with a neglect of neither. Surely the doctor of two or three generations ago, if his medical education had not grown with the times, would be unable to successfully compete with the best of today if his whole dependence lay in the skilful use of his five native senses.

Certainly we can hopefully believe that we have passed the time

when the fate of the *chronically* ill patient depends upon the diagnostic touch of the educated hand or finger alone. It was suited perhaps to fifty, even twenty, years ago, but not today. Clear cut physical findings, coupled with a history of the case such as is furnished in acute appendicitis, a perforated viscus, or the general picture of acute hemorrhagic pancreatitis, of a ruptured spleen or of ectopic gestation, to mention just a few simple illustrations, as our surgical knowledge grew, was enough to warrant the immediate opening of the abdomen and make use of the life saving scalpel without any further diagnostic delay. But after passing through this era and learning the lessons from our failures, the important asset of *surgical judgment* became more ascendent, and in certain types of appendicitis and other truly surgical conditions we have learned that it is not always the wiser thing to operate immediately, but to tide over the period of acute abdominal shock with measures developed in our experimental laboratories which were utterly unknown fifty years ago. Furthermore, most of us have recollections of a picture of the apparently acute surgical abdomen needlessly opened, where the pathological process was later found to be a double empyema with diaphragmatic spasm due to diaphragmatic irritation or subdiaphragmatic peritonitis which produced the abdominal picture. Likewise, a review of the history of the gastrointestinal crises of spinal syphilis is punctuated with the tombstones of surgical errors.(1). Nuzum (2) in his study of 1000 tabetics found that 97 (or nearly 10 in every 100) had been operated on under the mistaken diagnosis that the gastric crisis was an expression of some form of abdominal surgical disease, and yet nothing was found intra-abdominally to account for the symptoms. The reasons for such glaring diagnostic failures is because, even in the comparatively simple diagnostic field by means of the five senses, neglect is made in carrying out a complete physical and technical examination of the body.

Now let us take stock of the various elements that should enter into our diagnostic study of each patient presenting symptoms of chronic ill health. Theoretically, all of them should be used as a matter of routine. Practically this is not always possible. The various steps in diagnosis are fundamentally based upon a carefully and exhaustively taken history, upon a physical examination which should be complete and comprehensive, both of which should be amplified by technical studies. These will often include instrumental examinations of the mouth and its connected appendages, of the esophagus, the stomach, the gall-tract, the small intestine and the recto-sigmoid. Added to this will come diagnostic impressions gained by general laboratory studies of body fluids or materials obtained by both direct and indirect means, together with laboratory

studies of the composition of the blood, as to its quality and purity, its chemistry, its serology, its agglutination and its complement-fixation. No gastro-intestinal diagnosis can be considered complete without making use of the roentgen ray laboratory, although if the clinical study is carefully conducted its help is less indispensable. Other aids in the total completion or association of diagnosis may require technical procedures beyond the scope of the usual diagnostic office, such as cystoscopy, urethral catheterization, or the more elaborate studies in metabolism which require more extensive laboratory apparatus than can be conveniently housed.

Finally, in certain instances in order to cover a total survey it becomes necessary to refer certain patients for special and more technical examinations by a thoroughly skilled ophthalmologist, aurist, neurologist, psychiatrist, and less frequently to an orthopedist or gynecologist. From such detailed examinations we not infrequently derive important additional diagnostic data in regard to collateral or contributory minor diagnoses which will materially aid in developing a total diagnostic conception of the case and will furnish important suggestions as to such additional therapeutic procedures which must be added to the total management of the patient.

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CHAPTER IX.

DIAGNOSIS.—(CONTINUED.)

THE HISTORY.

THE main object of this book is to present the subject of gall-tract disease from a somewhat newer aspect than has heretofore been discussed, to attempt to bring into more definite relief certain pictures of catarrhs, inflammations, infections, adhesions and calculus states which involve the bile ducts, gall-bladder and liver, by a new method of diagnosis, the application of which lends itself equally well to the successful treatment of certain selected groups of cases. Since the investigative field of gall-tract disease lies clearly within the province of gastro-enterology, and since the latter is so closely linked up with the subject of internal medicine in general, as well as of abdominal surgery, it has appeared to me to be essential for my personal understanding of disease involving the abdomen (and particularly its upper right quadrant) to develop a practical and systematic, and comprehensive method of studying such cases. In other words, a method of systematic record keeping of histories, physical findings, laboratory data and progress notes of cases requiring differential diagnosis, especially as such a system bears upon gastro-enterology.

The general system of record keeping which I am presenting, although a gradual evolution, has been in constant use for the past twelve years, first in my office, and very shortly afterward was applied practically in the Gastro-enterological Department of Jefferson Hospital. At first the plan was limited to the working out of an historical and examination sheet which could be used for the purpose of routinely and consistently collecting on each patient a record of detailed general notes and of special symptoms, which would serve for the furnishing of accurate statistics for further use in literary or other channels. Realizing the importance of a method of history taking which could be turned over to students or to clinical clerks, *after* they had been sufficiently drilled to secure reliability in their history notes, it seemed best that the history and physical examination charts should be printed in such a way as to furnish systematic memory guides, as well as to limit unnecessary and extraneous clerical entry which might have no direct bearing on the case. Certain laboratory charts were similarly devised and put into use, but as practical experience grew all of these have been modified

from time to time through the help of associates and assistants.* It is quite obvious that this particular set of record keeping forms has been designed from a gastro-enterological standpoint, but having a due appreciation of the necessity of keeping in close relation with the subject of internal medicine. I do not doubt that much better charts than these could be planned out, especially when needed for the specialistic study of other groups of patients, yet as the years have passed this set of forms has fulfilled my expectations, and has made it comparatively easy to review larger and larger series of patients with gastro-intestinal disease with a facility far greater than would be possible if individual data upon a certain symptom or group of symptoms had to be dug out from histories and records kept in the usual manner.

I am very well aware that such a system has its limitations, particularly in its application to the method of taking the history and the recording of the physical examination. Criticism can readily be made of attempting to condense the historical statements and physical findings within the limits of the space allowed. No doubt in many instances a more consecutively running historical narrative and a more amplified description of physical findings may better suit the necessities of the individual case. But the amount of clerical entry thus needed materially increases the time consumed, and often, too, with errors of omission because all definite data to be collected is not brought to the attention of the doctor, student or clinical clerk responsible for the history.

To record, assemble and interpret the data obtained by history taking, physical examination and special examinations, such as roentgen ray, gastric analysis, intestinal motility and non-surgical biliary drainage, besides the various clinical laboratory reports, such as urine, blood, fecal and spinal fluid chemistry and microscopy, phenolsulphonephthalein elimination, allergy reactions and sputum microscopy, it is necessary to have for ready reference all of these facts, placed on separate and individual sheets, measuring $9 \times 11\frac{1}{2}$ inches, preferably of different colors.† The history and preliminary physical examination sheet in the series is white. The gastric analysis sheet, with the laboratory blank on the reverse, is pale blue; while the biliary drainage report sheet is yellow; and the intestinal motility sheet is brown.

The four page "diagnostic summary" form is also white and is the key to the patient's whole condition. It is compiled from the other sheets after the case has been completely worked up, and is used as a quick reference summary in reporting to the physician sending

* Especial mention is due Drs. H. J. Bartle and R. T. Ellison and Miss M. G. Pennypacker.

† The various charts here referred to are tabulated in Figs. 52 to 54 and in Figs. 60 to 65.

the case for diagnosis, or, if the case be under our treatment, when it becomes necessary for us to refresh our memory concerning the function or pathology of one or more organs, this can be done with facility. It furthermore becomes necessary where two or more physicians are handling a case over a long period of time, to have a general outline of the plan of treatment that is to be followed throughout with each patient. This is done by entering after the various topics of treatment on the fourth page of the "diagnostic summary" form just what the campaign will be in an endeavor to bring the patient back to health.

The "progress" sheet is plain except for ruling dividing it into three columns. In the first the date is placed at each subsequent visit. In the second, the widest column, the progress notes are written, and in the third treatment suggestions and prescriptions. Thus reference to previous treatment is greatly facilitated and the prescriptions are not jumbled up with clinical notes.

The extreme necessity for thus systematizing this record system became greatly emphasized when we recently undertook to review 100 gall-bladder cases, and this work could have been greatly expedited if we had had such a system in use at that time. To prepare that paper, (2) which required reference to many parts of history records to check up over three hundred different items for each case, meant hours of searching through heterogenous entries, before the necessary data could be obtained.

Let us now consider the working out of a study on a patient presenting for diagnostic survey with especial complaints involving the gastrointestinal tract.

THE HISTORY.

Recognizing that the history and physical examination of the patient has always been, and probably will always be, of fundamental importance, all practical details have been considered and included, but in a somewhat skeletonized way, the positive, as well as the negative factors of which can be summarized or amplified if desired in the space left to record the chronicle of the present illness, which, if not large enough, can be carried forward to a second progress sheet.

The general method of taking the history is that in common usage, namely, not to ask the questions in a leading or direct way, but to frame them largely in the negative manner. Often this does not suffice. If the historian is still in doubt as to whether he has secured the correct answer to any particular question it is a good plan to temporarily drop this line of inquiry and return to it later on in connection with some other phase of the history.

The general arrangement of the history form (see Figs. 52 and 53) also follows the usual custom of acquiring data as to age, sex, occupation, and under the latter I find it an advantage to go back and group past occupations under (*a*), and present occupations under (*b*). For instance, a patient may have formerly followed the occupation of a painter, but recently has changed his calling. One might therefore easily miss the association of abdominal cramps due to lead colic, being misled by a misinterpretation of the lack of occupational connection with the present disease. Similarly, this statement can be applied to other occupational diseases.

Next comes a review of the family history and the possibilities of heredity or close family contact in disease production. Throughout the history form every possibility of short cutting clerical entry without losing the elements of detail or exactness has been considered. Most of it is self-explanatory. However, in regard to the taking of the family history one point in explanation may be helpful. The letters "B. l. w. s. d." (see history form page 182) stand for: Brother (or Brothers) living, well, sick, dead. For instance if a patient has had 4 brothers, 2 of whom are living and well, 1 is sick or in ill health with cardiorenal disease, and 1 has died of pneumonia at the age of forty-two, all of this can be concisely and

expeditiously written as follows: B. l. w. s. d.—42 pneumonia.
 —45 cardiorenal.

Following the family history the patient's past illnesses are recorded. Particularly important in digestive diseases is the previous history of infection. As a rule the childhood diseases play a less prominent part. However, diphtheria and tonsillitis, especially the latter when recurrent, are of great importance, not only in the fact that it may have already disseminated or transferred its bacterial infection to the gastro-intestinal tract, but may also remain behind as a localized focus. So, too, the common infectious diseases, such as influenza, particularly those cases occurring during the pandemic years of 1918 and 1919, pneumonia, pleurisy, chronic bronchitis and other conditions involving the bronchopulmonary system, will frequently be found to be the starting point in many gastro-intestinal diseases. Any such respiratory disease, as well as oral sepsis, which permits of the ready swallowing of pus and bacteria, *is a very direct cause of gastro-intestinal disease.* Likewise the connection between typhoid fever in the production of cholecystitis and gall-stones is well known. A history of jaundice, even of mild degree, is important. An attack of apparently simple catarrhal jaundice may be found by later direct examination of the gall-tract to have seriously affected the gall-bladder or liver or pancreas.

Name		HISTORY.		Phone		Date	
		Residence					
Age		Nativity		Referred by		Result	
S. M. W. Occupation { A B							
Diagnosis							
Chief Complaint							
Family History, F. l. w. s. d.		M. l. w. s. d.					
B. l. w. s. d.		S. l. w. s. d.					
T. B.		Cancer		Renal		G. I.	
Cardiac							
Past Medical History: scarlet fever, diphtheria, tonsillitis (recurrent), rheumatism, influenza, pleurisy, pneumonia, typhoid fever, jaundice, malaria, dysentery, gonorrhea, syphilis, cramps, worms, foreign bodies.							
Operations		When					
General Health		Robust		Delicate		Last illness	
Marital History		Children		Miscarriages			
Menstruation		Tea		Coffee		Alcohol	
						Tobacco	
Previous Indigestion:						Drugs	
				Abdominal Pain			
				FIG. 52 A.			

Renal System	Nervous System		
Cardiac System	Genital System		
Pulmonary System	Ductless Glands		
Weight (today)	One year ago	Best weight	Height
Present Illness	Six months ago	Symptoms	

Provisional (mental) Diagnosis

FIG. 52 B.

Thirst		Breath: { Normal { Offensive		Peristaltic Unrest Pyrosis	Dysphagia Aerophagia
Appetite	{ Normal { Perverted { Anorexia { Satiety	Taste: { Normal { Sweet { Sour	Nausea: { Constant { Intermittent		{ Sour Regurgitations; { Acid { Band
Headache:			Backache		Vertigo
Lack of abdominal support			Easily fatigued	Ticklish	
Foods disagree					
Foods agree					
Pain or Distress					
Localized where				Boring	Sense of weight
Referred where				Stabbing	" pressure
Constant				Empty	" discomfort
Intermittent					Bloating
Time					Belching, relieved by
Relieved by food taking					Passing gas, relieved by
Increased by food taking (liquid)					
Vomiting	(induced)	(involuntary)	(solid)	Position { Best { Worst	Pressure
Character			Time	Relief	Hematemesis
				Retention	
Bowel movements:	normal	painful	offensive	hard	lack power
shape		mucus	color	Bloody discharges	Hemorrhoids

FIG. 53 A.

Constipated: moderately { Constant
Intermittent
obstinately { Constant
Intermittent

PHYSICAL EXAMINATION: T. P.

General appearance

Skin

Nose

Teeth

Reflexes

Thorax

Heart

Abdomen

Tenderness

Liver

Stomach: Size

Colon

Anus

Pelvis

Spine

Use of Laxatives { Constant
Intermittent

Use of Enemas { Constant
Intermittent

R. Bl. P.

Musculature

Ears

Tongue

Extremities

Rombergs

Arteries

Eyes

Tonsils

Glands

Kidney

Mass

Scar

Hernia

Rigidity

Adhesions

Appendix

Sigmoid

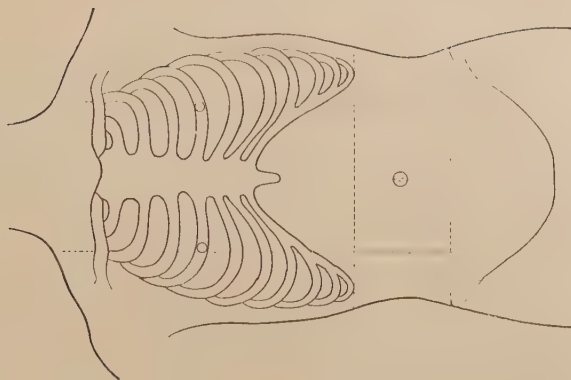


FIG. 53 B.

Jaundice of the recurrent variety over a number of months or years has a message of its own. Dysentery, as distinguished from brief intermittent periods of simple diarrhea, gives suggestive pointings. The venereal diseases, certainly gonorrhea, of themselves do not so frequently involve the digestive tract, although syphilis of the stomach and liver is by no means uncommon. Although this group of diseases does not play so direct a role, nevertheless they cause so many disturbances in collateral or dissociated organs as to make their recognition of great help in the planning of general management.

An antecedent history of worms, with an effort made to ascertain the type and their last noted appearance, is sometimes of vital importance. I have a clear recollection of a little girl, aged eight years, who was referred for obstinate constipation and attacks of vomiting, who was anemic and obviously ill, in whom not even a stool examination had been made. During the course of a gastric study reverse peristalsis was developed, and the child vomited several round worms. Within the next twenty-four hours symptoms of acute intestinal obstruction developed with acute prostration requiring operative interference. After opening the abdomen a large mass of round worms, many hundreds of them interlaced in a mass as large as a base ball, was removed from a point just proximal to the junction of the ileum and cecum. A single examination alone of the stool was sufficient to find the characteristic eggs of *Ascaris lumbricoides* in great abundance, and yet the diagnosis of such a simple case went unrecognized for many weeks or months.

Also it is important to inquire as to the history of the swallowing of foreign bodies, for it has been quite surprising to learn the frequency with which, particularly in younger people or in the parents of children, there is a recollection of this occurrence. Very often these swallowed objects do no damage, but pass harmlessly through the intestinal tract. Again, however, they may cause serious difficulties. Quite recently I saw a baby who was suffering with acute abdominal pain, and whose bowels, from a normal state had become first constipated and then obstructed. On closely questioning the nurse it was learned that this twenty months old child had been chewing wood from the arms of its chair and such pieces of wood as it could lay its hands on. On washing its stomach many fine splinters of wood were recovered and subsequently a large amount of wood, certain of them splinters from 1 to $1\frac{1}{2}$ inches long, was recovered from the baby's stools, the passage of which was accompanied by very evident acute distress.

The list of past illnesses recorded make up the more important ones. A blank space, however, is left for the entering of other illnesses when required. It is a good plan in the history taking to underline each disease which the patient has had, and to score over

it the year and the duration and any recurrences, as these serve to increase the value of its association with the present complaint. So, too, a space is left for a record of the last illness and its time, duration and severity, and whether it required bed rest, should be noted. A record of all previous operations, no matter of what kind, should be carefully taken, the date, the name of the surgeon and his hospital should be secured. Very often it is of great advantage to know this so that we can get a more definite account of the operative condition by referring an inquiry to the doctor or the hospital. Particularly is this important in operations in which the abdomen has been opened. In this connection I might mention the frequent failure of securing from certain doctors who operate in the less efficient hospitals any definite data as to the details of what was done or what was found, simply because no records were kept. This of itself is sufficient excuse for going into this somewhat burdensome résumé of history taking, and emphasizing the need of a proper recording of important details. As will be seen by reviewing certain case reports (see Chapters XXVII to XXXVI), the mere chronological order in which certain nose and throat and abdominal operations have been done will give a very suggestive historical picture of the development of the major presenting complaint.

A brief note as to general robustness or a tendency to delicacy in health is useful. Sometimes it will be found that the patient has enjoyed excellent health up to a certain age, when a series of illnesses have increased the delicacy in health or have developed a proneness to disease. Or this story may be reversed and a patient who has been ailing and delicate throughout childhood may outgrow such tendencies and enjoy a period of one or more decades of robust health.

While especial inquiry into the menstrual and marital and child-bearing histories may not be strictly pertinent in the working out of a gastro-intestinal picture, it nevertheless develops certain important points in their relation to clinical medicine, including endocrinology, which may add something to the general diagnostic survey.

The general habits in regard to the use of tea, coffee, alcohol, tobacco and the use of drugs, such as tonics, alteratives, laxatives, specifics and narcotics or patent medicines, are useful matters of record, both in the way of diagnosis, and as suggestions for the future management of the patient. Here, too, should be recorded, although space is not specifically reserved, the data as to regular or hurried habits of eating, the tendency to skip meals, particularly breakfast or lunch, and for what reason, and whether the patient uses home or restaurant cooking.

A careful inquiry in regard to previous indigestion prior to the

development of the present illness often gives suggestive leads as to the early beginnings in the life history of the present complaint. For instance, it is not unusual to hear the statement that the patient has suffered from constipation or indigestion all of his life, from his earliest recollections in childhood. Such conditions usually have been functional in their beginnings, but due to continued bad habits in the care of the bowels or in the manner of eating, with later superimposed infection, the functional disturbance has gradually passed into a condition of structural damage or organic disease. Or again we may learn that a true peptic ulcer of corrosive acid gastric juice causation may have shown its earlier beginnings in a history of several years of preceding intermittent indigestion with heartburn, pylorospasm, rise of intragastric tension, developing one to two hour postmeal pain. But at this earlier time these symptoms were of less severity and duration, spaced with a greater intermittency and frequently showed a tendency to seasonal incidence, and were made worse by sedentary overwork or by worry. Or again we may receive a historical impression of the beginnings of gall-tract disease when we hear a story of biliousness with periods of constipation, a tendency to seek relief by calomel and salts, perhaps migraine, a vague sense of upper abdominal discomfort, later a development of gastric fermentation with belching, a tendency to biliary regurgitation due to dysfunction of Oddi's muscle and duodenitis, and an inability to digest fats and foods rich in purins. All of these and many other diagnostic leads historically may suggest the beginnings of gall-tract disease, which precede the more understandable symptoms of right costal margin pressure-distress or pain, or shoulder-blade ache, or more typical gall-tract colics. In this earlier stage they cannot be definitely recognized and differentiated from other conditions that produce similar symptoms, such as we see in certain forms of chronic appendicitis, or the beginnings of ileocolitis, unless we make use of our abilities to now do a diagnostic drainage of the gall-tract, coupled with studies of gastric and duodenal secretions and with various intestinal studies. In this period of early beginnings of gall-tract disease therapeutic non-surgical drainage of the gall-tract will cure the majority of these cases, and prevent them from developing later states of pathology.

Again, inquiry directed to previous attacks of abdominal pain as distinguished from distress or discomfort will often bring out histories suggestive of appendicitis, tubo-ovarian disease, kidney or ureteral colics, or the old-fashioned "belly aches" due to enterocolitic spasm following dietetic indiscretion.

Having reached even this stage in the historical narrative one cannot help but be impressed with the connection of disease or dysfunction which manifestly involves *many* parts of the gastro-

intestinal canal. If we want to accomplish permanent cure of the diseased area and a restoration of total function, it is not simply a question of diagnosing appendicitis, cholecystitis, duodenitis, or gastric ulcer, but we must proceed to work out the associated or collateral conditions in every part of the tract from mouth to anus, and correct them as well. Not infrequently we find multiple lesions in the same patient, often all of them traceable to the same etiological factor. That is, the patient may have cholecystitis, duodenitis (or ulcer) and appendicitis, all produced by infection focalized in the teeth or tonsils.

The longer I have been concentrating the greater part of my time upon this subject the more I have become convinced that the *commonest single cause of gastro-intestinal disease is infection*, and that the commonest source of infection will be found in the mouth and its connected appendages, the gums, teeth, tonsils, sinuses, nasopharynx or the bronchial tree. It is quite impossible for any of us to entirely avoid the swallowing of contaminated and infected materials which enter the mouth, even though we are in a reasonable state of consciousness and have a knowledge of its danger. Therefore, when one is ill with severe influenza or delirious with broncho- or lobar pneumonia the chances of gastro-intestinal infection from this source are vastly greater. Those of us who suffer with chronic nasopharyngitis, and who during the night have purulent mucus droppings in the nasopharynx, should take thought to how infrequently we get out of bed to spit out this infected material. It is so much easier to swallow it that we do it almost unconsciously. We get by with this for a while because the gastro-intestinal tract is provided with certain native defenses against the pyogenic or pathogenic bacteria which are passing through its transit tube. Many parts of the mucosal surfaces develop secretions which are normally inhibitory to bacterial growth. In addition to this it is a general bacteriological law that different bacterial groups can thrive luxuriantly only in a habitat to which they have become acclimatized. So that we find later on when the bacterial dosage becomes increased that the native defenses gradually weaken, and functional disturbances develop which in turn still further impair the native antibacterial efficiency. The peristaltic rhythm becomes disturbed, usually the processes of digestion are thereby altered, and the fecal current usually becomes slowed, so that these pathogenic bacteria are neither so rapidly killed off by the native defenses, nor so rapidly passed through the transit tube. They can linger at different areas of predilection to a certain extent governed by the physiological nodal points described by Keith, (1) and can begin to thrive, colonize and still further weaken the defenses of the gastro-intestinal tract, until finally they have caused organic structural disease which

then furnishes a proper pabulum for their further acclimatization. Therefore, it seems logical that the primary likelihood of infection of the gastro-intestinal tubing might be described in terms of bacterial dosage plus the virulency of the infecting organism plus the tissue resistance of the host.

I have felt for a long time that insufficient stress has been laid by previous writers on the greater likelihood of *direct* infection of the gastro-intestinal tract. Emphasis has heretofore been laid perhaps too strongly upon the route of infection as being carried through the blood. This is, of course, unquestionably proved in certain cases, is clearly conceivable in conditions such as typhoid fever, and certain other diseases. But why do we not see it more frequently as a direct sequel to general septicemias, such as puerperal sepsis, malignant endocarditis, or even simple acute inflammatory rheumatism? Doubtless the gastro-intestinal tract may become infected through such means, but certainly a close perusal of a series of carefully studied cases will show the greater tendency of direct infection by the ingestion of bacterially laden materials. In certain cases both the indirect and direct routes of transplanted bacterial infection have taken place. After any part of the gastro-intestinal tract has been successfully attacked and invaded the bacteria may and do pass into and through the walls and are taken up by lymph or blood channels and carried into the portal circulation, and thence transferred or disseminated to any other part of the tract which shows a *locus minoris resistentiæ*. It is thus we see infection transferred from the appendix to the gall-bladder.

If the systemic blood borne route of infection is the *commonest* avenue, I have a right to be much disappointed with the nearly absolute negativity of blood cultures which have been so frequently made on my patients in whom I suspected an infection carried through the blood stream. In my experience they have only with the greatest rarity grown out a positive culture in chronic cases, undoubtedly toxemic, and even in acute cases, such as acute follicular tonsillitis, acute inflammatory rheumatism, acute or chronic vegetative endocarditis, it is comparatively very infrequent that the blood culture is positive. It may be that the fault lies in the laboratory as to the selection of culture media, or for other reasons, but I have every reason to feel the greatest confidence on this score. It is conceivable that an infection within the abdominal tract which is passing from one locus to another may be confined to the portal circulation and not reach the peripheral blood stream. It may seem irrelevant to discuss this question of bacterial infection of the alimentary tract at such length, but it seems to me important to bring it out at this point to emphasize in the history taking the necessity of going deeply into even the *simpler* infections, and

attempt to trace out by history alone the sequence and, if possible, the pathways of events.

Returning now to the discussion of the history chart, the next inquiries are directed to securing notes of symptoms involving the renal, cardiac, pulmonary, nervous, genital and endocrine systems. These notes can be very briefly entered here and amplified, if necessary, in the space reserved for the present illness.

In regard to the nervous system we should try to note whether the patient is phlegmatic or excitable, a "worrier," under repressed tension, introspective, emotional and so on.

Furthermore, I have found it interesting to inquire specifically regarding the habits of sleep. The number of hours usually allotted to sleep; whether the patient wakes refreshed or heavy, dull, head-achy and unrested even after eight to ten hours of sleep; whether he is subject to dream states, nightmares and their character (fantastic, bizarre, terrifying, and a tendency to recurrence of the same type); subject to muscular twitchings which jerk him half awake, or to muscular cramps (usually toes and legs); or subject to insomnia, and, if so, of what type and due to what cause.

Such an inquiry is not only interesting, but diagnostically important, for the sense of unrefreshment after long hours of sleep, and especially if accompanied by disturbed sleep states of twitchings, bad dreams or muscle cramps, *will often be found associated with hepatic or intestinal toxemias or disseminated focal infections.*

Also it will be found helpful to inquire into the state of mental happiness or discontent, into the desires, the ambitions or the regrets of the patient, so that later when the case is fully worked up and the plan of treatment mapped out, the patient may be enjoined to practise the "doctrine of contentment" or large doses of "Hope" may be prescribed. For certain individuals this will prove more efficacious than the most highly compounded chemical therapy or the most skilfully performed operation.

Next comes the question of securing information as to both a possible gain (important in endocrine disturbance and in diabetes) or possible loss in weight (important in cancer, tuberculosis, syphilis or certain infections). Both are important and it is well to have a record of this over at least a period of a year. A record of weight is of little value unless interpreted in terms of the height, which should also be recorded.

In connection with writing out the story of the present illness I find it most helpful to make a note as to whether the symptoms recorded are progressing in their severity and subjective importance, or whether they have been stationary over a period of time, or whether they are improved at the present writing of the history by comparison with a few weeks or months prior.

Before proceeding to enter the present illness in narrative form, a more direct record of numerous symptoms, which particularly are associated with the gastro-intestinal tract, are briefly but routinely recorded on the reverse of the history sheet, both for the purpose of securing this data in each individual case, and also to have an accurate method of compiling and interpreting statistical reviews of a series of similar cases. (Cf. history form, Fig. 53A).

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DIAGNOSTIC SUMMARY OF

Report to Dr.

SUGGESTIVE HISTORICAL EVIDENCE:

Case No.

Date,

PHYSICAL FINDINGS:

Weight,	T,	P,	R.	B.P.
Habitus,	= (gain—loss—	lbs. in	mos.	Height,
Hair,			Posture,	
Skin,				
Musculature,			Reflexes,	Romberg's,
Glands (lymph),				
Bones and Joints,				
Extremities,				
Vasomotor System,			Arteries,	

HEAD:

Face,	
Eyes,	
Pupils,	
Ophthalmoscopic,	
Nose,	
Sinuses,	
Ears,	
Mouth,	
Gums,	
Teeth,	
3rd Molars,	
Tongue,	
Palate,	
Anterior pillar,	
Tonsils,	
Pharynx,	

Rt.

Lt.

Dentures,

Dead,

Caps,

NECK:

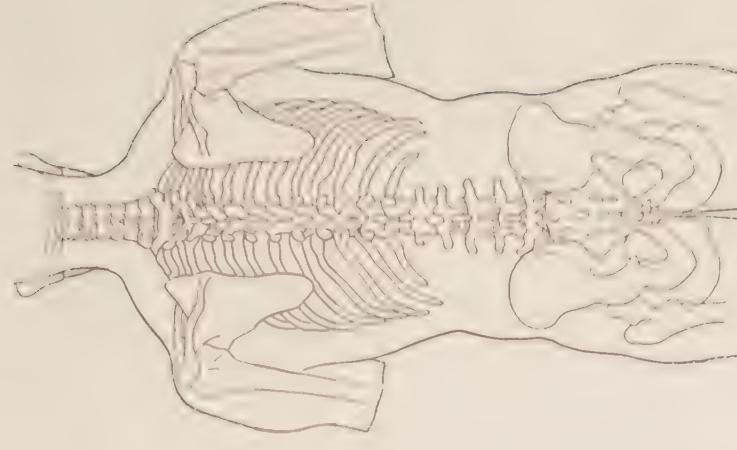
Veins,
Thyroid,

CHEST:

Breasts,
Lungs,

Mediastinum,
Aorta,
Heart,

Electrocardiograph,

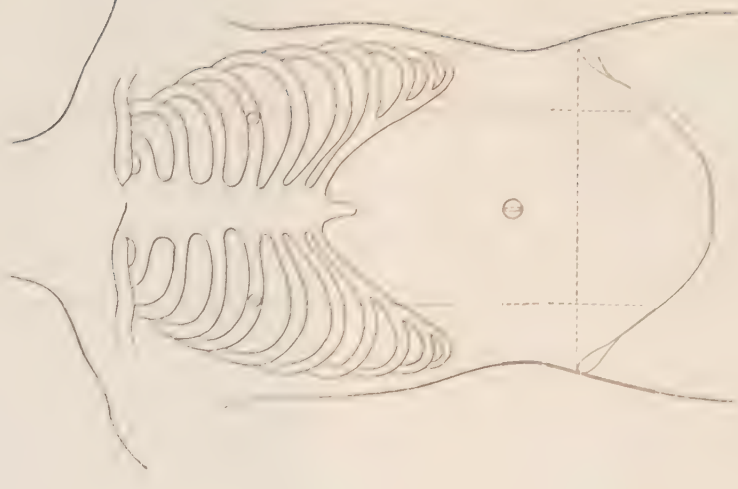


ABDOMEN:

Glenard Test,
Aorta,
Scar,
Reflexes,
Mass,
Hernia,
Pain,
Tenderness,
Rigidity,
Adhesions,
Kidneys,
Liver,
Gall-bladder,
Spleen,
Stomach,
Small Intestine,
Appendix,
Cecum,
Colon,
SPINE:

Costal Angle,
Iliac Arteries,
Muscular Tonus,

Ptotic Index,



Coccyx,

SPECIAL PHYSICAL EXAMINATIONS:

RECTO-SIGMOIDOSCOPIC:

Anus,
Rectum,
Sigmoid,

PELVIC:

EXTERNAL GENITALIA:

ENDOCRINE SYSTEM:

ESOPHAGUS:

SUMMARY OF SPECIAL ANALYTICAL EXAMINATIONS:

GASTRIC EXTRACTS:

DUODENAL EXTRACTS:

BILIARY DRAINAGE:

HEPATIC FUNCTION:

PANCREATIC FUNCTION:

INTESTINAL MOTILITY:

FECEs:

URINE:

1. Chemical,

2. Micros.,

3. Special,

KIDNEY FUNCTION: (Intramuscular 'phthalein)

BLOOD:
Routine Exam.,

Chemistry,

Wassermann,

BACTERIOLOGIC:

X-RAY STUDY

SPECIAL STUDY

% .

cc

hrs.

DIAGNOSIS:
MAJOR,

COLLATERAL,

PROGNOSIS:

PLAN OF TREATMENT SUGGESTED:

Diet,
Lavage,
Biliary Drainage,
Colonic,
Rectal,
Abdominal Support,
Electricity,
Subcutaneous,
Percutaneous,
Intravenous,
Vaccine,
Medicinal locally,

Hygiene,
Exercise,
Rest,
Operation,
Special,

FURTHER EXAMINATIONS REQUIRED:

REPORT OF OPERATION:

CHAPTER X.

DIAGNOSIS.—(CONTINUED.)

THE PHYSICAL EXAMINATION.

It will be found likewise that the method of recording the physical examination is also skeletonized, although it includes most of the practical essentials of a routine physical examination. If merely quick or snapshot diagnosis is required in an individual case, the abbreviated physical examination is carried out on the reverse of the history form. (See Fig. 53 B, page 185.) If a complete study is being made a more complete physical examination is carried through and scored on the first and second pages of the diagnostic summary sheet. If greater space is required for the recording of any special point in the history or physical examination it can be starred in its respective space and carried forward to the blank sheet used for progress notes.

It is not necessary to go into great detail as to the method by which all parts of the physical examination is to be conducted. The great essential is that the physical examination should be complete from the hair of the head, if necessary, to the soles of the feet.

It is needless to say that the patient should be properly prepared for examination and should be examined in a good light and in the proper position. Men should be stripped to the skin and properly blanketed for warmth. Women should also be stripped, put into a kimona, and properly protected with a sheet or towels as each limited zone of the body is examined. If possible a trained nurse or woman assistant should be present at such examinations of women.

The usual sequence of examination by inspection, palpation, percussion, auscultation and, if necessary, mensuration is followed. The examination should be carried out in an orderly and systematic manner, and after much personal experimenting I have found that the sequence which is followed on the diagnostic summary sheet is practical, convenient and economical in time consumption without stinting thoroughness. (See accompanying chart, Fig. 54.)

It is not the purpose of this book to consume space in detailing the methods of examination of the hair, skin, musculature, etc.; or of the head, neck or chest. But particular care should be given to a search for focal infection of the mouth, rectum, pelvis and genitalia.

Certainly no physical examination is complete without a pelvic examination in women, and a rectal examination, both digital and procto-sigmoidoscopic in both men and women.

EXAMINATION OF THE ABDOMEN.

In abdominal examinations I feel that much suggestiveness in the way of differential possibilities comes from a routine recording of the type of the costal angle, of abnormal floating ribs, and whether or not the abdominal aorta, and in certain cases, the iliac arteries, are completely or partially uncovered, are displaced or have unusual superficial throbbing, or are tender. This aids in a rapid but routine classification of the *habitus* of the individual, whether sthenic, hypersthenic, hyposthenic or asthenic, and a better judgment in the interpretation of their complaints. To this can be added measurements to secure the *habitus index*. This will be remembered as being the distance in centimeters from the suprasternal notch to the top of the pubic bone divided by the smallest waist measurement also taken in centimeters, 0.70 being the average measurement for the normal sthenic. An index passing from 0.70 upward through 0.80, 0.90 and above represents the hyposthenic habitus passing into the asthenic or clean cut congenital visceroptotic, whereas the index passing downward from 0.70 reaches the apoplectic habitus when it drops to 0.55 or below. In a general way I find this method of classification extremely useful, and I am glad to see that my experience has borne out the observation of others that the hyposthenics, asthenics or visceroptotics are distinctly more prone to suffer from functional disturbances (to which, of course, can be added at any time organic disease), whereas the hypersthenics or apoplectics have a greater tendency to avoid the functional disorders, but are more apt to be found suffering with organic complaints. In a general connection with this I find that the states of the pupil and the pupillary reflexes, excluding tabes, when compared with the readings of blood-pressure taken in the sitting, lying or Trendelenburg positions, is helpful in distinguishing between the vagotonics and the sympathicotonics, which, as is well known, points to a tendency of the individual to suffer from either functional disorder or organic disease. A performance of the Goetsch test will aid us here. Also pressure made on the eyeballs which reduces the pulse rate in vagotonics is a helpful test.

There are a few points in the physical examination that it might be wise to briefly discuss. First, in regard to examining certain abdominal organs. It has been my personal experience that the *gall-bladder* is an organ which lends itself to ready palpability very much less frequently than I would judge to be the experience of

others, particularly the surgeons, whose manuscripts and books in their citation of cases mention so frequently a palpable gall-bladder. I by no means deny that it is, under certain circumstances, a palpable organ, but due to its anatomical position on the under surface of the liver, and in turn protected by the arching of the costal margin, I maintain that the patient must have thin and relaxed abdominal walls and the gall-bladder must be very much more than usually distended before it can be reached and definitely recognized by the educated hand even with bimanual palpation. Except in the case of a non-inflammatory hydrops, when the gall-bladder is the seat of disease and is enlarged in its longitudinal direction, my experience has been to find the upper right quadrant in a state of such increased muscular rigidity or spasm as to make the detection of even a distended gall-bladder not an easy matter. One frequently, but vaguely, receives a palpation impression of a mass in the upper right quadrant, but I have noticed in following such cases to the operating table that on exposing the gall-bladder it is quite as often found shrunken, fibrous and atrophic, and that the suggestion of a mass thought to be the gall-bladder was caused by inflammatory thickening and adhesions, or simply the recti linæ transversæ. Again, the obese subject is more prone to develop gall-bladder and gall-tract disease, and in these cases abdominal palpation is distinctly more difficult. Of course, we know that the gall-bladder can and does enlarge and distend to occasionally enormous proportions. I remember seeing such a case operated, under the mistaken diagnosis of an ovarian cyst, in which the gall-bladder filled the larger part of the right abdomen and extended well down into the pelvis. Occasionally one reads or hears of a gall-bladder that when surgically evacuated was found to contain more than a liter of fluid contents.

When the gall-bladder is found enlarged it is sometimes necessary to differentiate between it and a movable right kidney. In the latter case the mobility is more apt to be found in an up and down direction rather than laterally, and after deep inspiration has brought it down expiration will snap it back from beneath the fingers and palm of the right hand into its nephric position in the right loin space. The palpable gall-bladder, on the other hand, although it, too, moves downward on deep inspiration, has more of a longitudinal or lateral mobility and as it moves upward on expiration it passes from beneath the palpating hand more directly toward its normal position at the costochondral juncture of the ninth rib.

In palpating for *gall-bladder tenderness* it will be found that the right upper rectus is slightly more resistant normally than is the left upper rectus perhaps on account of the lower position of the right lobe of the liver. This is a normal and physiological difference similar to the slightly increased percussion dulness of the poste-

rior upper pole of the right lung as compared to that of the left lung. The usual point of gall-bladder tenderness will be found in the upper third of a line drawn between the ninth rib and the navel. It thus very closely merges with the usual point of duodenal tenderness which lies at about the middle point of this line.

In examining for tenderness in the region of the gall-bladder or gall-ducts bimanual thumb pressure should always be employed at some stage of the examination. For this the patient should be lying on his back with the head and neck slightly raised and the knees comfortably flexed over a pillow, or with the soles of the feet comfortably placed on the bed. The examiner, sitting on the right side of the patient, places the thumb of each hand in each hypochondrium at the tip of the ninth ribs with the palm and fingers more lightly grasping the costal margins. With the patient nicely relaxed, after each successive deep inspiration the thumbs at expiration are more and more firmly pressed up under the costal margins. When the gall-bladder or gall-ducts are the seat of inflammation, even of slight degree, after the thumb has been firmly pressed upward on expiration, a further full inspiration will not only elicit pain, but will interfere with the free respiratory movement of the diaphragm on the right side. Where there are acute inflammatory adhesions or some localized peritoneal irritation there will also be brought out, as a rule, some protective rigidity and spasm of the upper right rectus muscle.

Another common way of eliciting gall-bladder pain is for the examiner to stand on the right side of the patient, but facing his feet, and with the fingers of the left hand tightly grasping and pressing under the right costal margin in the neighborhood of the ninth rib the patient is instructed to take deep respirations, and at the end of a deep inspiration the examiner smartly strikes the knuckles of the left hand with the closed fist of the right hand. This maneuver will almost invariably bring forth an exclamation of pain or distress from the patient possessing an inflamed gall-bladder.

In certain instances in which the upper right quadrant is in a state of intense muscle rigidity and spasm it may occasionally be necessary to put the patient in a tub full of hot water which will so help to relax the abdominal muscles as to make palpatory examination more easy.

A third maneuver for eliciting gall-tract tenderness when the gall-bladder or ducts are inflamed is by ulnar concussion described by Riesman. This consists of having the patient take and *hold* a full inspiration when the examiner strikes in turn both the upper right quadrant and the upper left quadrant with the ulnar edge of the hand. The examiner learns to differentiate gastric from gall-tract inflammation by comparing the subjective response to local-

ized tenderness on the part of the patient in the left upper quadrant with that in the right.

I have not personally been able to confirm the usefulness of delimiting the outline of the gall-bladder by percussion, although the differential test between an enlarged right kidney or an enlarged gall-bladder by inflating the hepatic flexure of the colon may be a theoretically useful procedure.

In regard to the inflation of any of the hollow viscera, particularly the stomach or the colon with either air or fluid to such a point of distention as to make them more diagnostically recognizable by palpation or percussion are methods of older use which I believe to be *distinctly harmful*, and can be laid aside and should be superseded by the more modern, more practical and less harmful measures. Particularly to be condemned is the older time-honored method of inflating the stomach with tartaric acid and sodium bicarbonate. Since the distensibility of any individual hollow viscus cannot be foretold, any method of gaseous inflation cannot be controlled, and I, as doubtless others, have seen one or more instances of serious collapse follow its use. It is at least twelve years since I last practised this method and finally discarded it.

The methods which I prefer for the mapping out of the size, shape or position of the stomach are the following:

1. *Tuning Fork Auscultatory Percussion.* This might better be called auscultation for the transmission of the tuning fork note. It is carried out as follows: I personally make use of a G, or G sharp tuning fork. With the bell of the stethoscope in the normal anatomical subject placed in the left epigastrium just below the costal margin it will rest upon the body of the stomach. By striking the tuning fork and placing its stem over the left costal arch just above we elicit the pure gastric note. Now by bringing the stem of the tuning fork in radial lines from the left axillary space medianward, and from the left lower abdomen upward, when this pure gastric note reappears again will indicate the marginal boundaries of the stomach (see Fig. 54 A). This method will be found to check up very nicely with other clinical procedures such as scratch auscultatory percussion, auscultation of small injections of air and with the visible record by roentgen ray of the position of the stomach.

2. *Scratch Auscultatory Percussion.* With the bell of the stethoscope in the same position as above the skin is gently scratched with the forefinger in the several directions outlined above until the marginal boundaries of the stomach are determined.

3. *Auscultation for Injected Air.* This is a simple and fairly reliable method, but requires the insertion of a stomach or preferably a duodenal tube through which is injected fractions of air from a 1-ounce syringe as the bell of the stethoscope is brought

up in radial lines from the axillary space and the lower abdomen until the air sound is clearly detected. The point of maximum air sound usually indicates the position of the tip of the tube, and, as will be seen later, (Fig. 108) this method is employed for the purpose of determining when the tip of the tube has passed through the stomach and has entered the duodenum. The clearness of this test can be enhanced by the patient drinking a half tumbler full of water to increase the intensity of the air bubbles. This, of course, should not be made use of if the chemistry of the stomach is to be examined.

4. *Determination of Size, Shape and Position of the Stomach by Roentgen Ray.* This is a method that gives satisfactory results very quickly and easily, but requires suitable roentgen ray equipment which is not always available to the average office, and therefore the clinical tests recorded above should be practised until one gains a personal efficiency in their use. By means of roentgen-ray visualization one gains information *other* than the position of the stomach; namely, the regularity and clean cut edges of the outlines of the stomach; and a fairly accurate suggestion of the rhythm and force and rate of the waves of peristalsis. Allowance must, of course, be made for discrepancies in size, shape and position of the stomach as determined by clinical methods when compared with roentgen-ray methods which require the use of a heavy fluid mixture of barium or bismuth, which, by its very weight, tends to distort the usual position of the stomach. For this very reason, this method, however, has seemed to me of great usefulness in determining the distensibility of the supporting peritoneal so-called ligaments or folds, and gives us a clearly defined picture of gastroptosis of various degrees. Determining a succussion splash in the stomach not only helps to locate its position, but gives us a quickly gained impression of disturbances in gastric motility.

A CLINICAL METHOD FOR DETERMINING UPPER RIGHT QUADRANT ADHESIONS.

An accurate clinical method of determining adhesions between the stomach or transverse colon and neighborhood viscera, but particularly useful for the detection of adhesions between the pyloro-duodenal segments and the under surface of the liver or other parts of the gall-tract, can be accomplished by making use of the transmission of the tuning fork note determined by auscultation. This I, perhaps erroneously, speak of as tuning fork auscultation. It is a method that I learned quite by accident nine years ago and have been routinely making use of in all cases studied during this period,

and now have hundreds of records of its use. Its reliability has been repeatedly checked, chiefly by roentgen ray in a large number of instances, by operative exploration, and where possible, by post-mortem inspection. So far as I am aware it is a method that has not been heretofore described. At the time I first accidentally realized its importance I was examining a patient in a hospital out-patient service, and for purposes of demonstration was making use of the various clinical methods of outlining the size, shape and position of the stomach outlined above. With the bell of the stethoscope in the usual position in the left epigastrium (Fig. 54 A), I had completed the mapping out of the left and lower borders of the stomach, and then placed the stem of the stethoscope above the right



FIG. 54 A

costal margin directly over the liver, and to my surprise I found the pure gastric note transmitted just as sharply and clearly *through* the liver as when the stem of the tuning fork was placed directly over the stomach. The obvious interpretation was that if this clear note could be transmitted through a solid organ such as the liver with the bell of the stethoscope directly over a hollow viscus (the stomach), therefore, some portions of these two organs must be in direct and *intimate* contact with one another. Proceeding with the study of this case it was found to be one of cancer of the stomach with pyloric obstruction, and at operation it was found that the terminal portion of the lesser curvature and the pylorus and part of the duodenum were densely adherent to the under surface of the liver which was involved in metastases.

This was the starting point in the use of this test. I then proceeded to routinely examine each abdomen for this purpose. In *normal* cases one does not ever get the gastric note transferred through the liver. Occasionally one hears it clearly transmitted to the left half of the right costal margin in normal cases, but on repeating the examination from time to time this transmission will not be found constant. In other words, it may then be caused by peristaltic waves carrying the pylorus and duodenum up under the right costal margin and thus bring them in temporary contact with the gall-bladder and under surface of the liver. Therefore, unless this transmitted note is heard easily and constantly on every examining occasion it should not be interpreted as adhesions.



FIG. 55

In *pathological* cases, however, I have learned to differentiate the following types which, as I have stated, have been confirmed by roentgen ray or by operation, as well as having certain other features appear in the clinical study of the case to support the suggestivity of adhesions involving this quadrant.

1. When the gastric note is transmitted by tuning fork to the left half of the right costal margin (see Fig. 55), and this phenomenon is found to be *constant* at each examination, I expect to find rather slight formation of adhesions between pylorus or duodenum and the peritoneal coverings in the neighborhood of the gall-ducts.

2. When the gastric note is transmitted by tuning fork to the costal margin in the region of the juncture of the ninth and tenth

ribs, but is not transmitted through the liver, I expect to find at operation that the adhesions are more likely to involve the gall-bladder.

3. When the gastric note is transmitted by tuning fork along the length of the right costal margin from the epigastric border to the anterior axillary line, and is very clear and distinct, and always constant, I would expect to find rather older and denser adhesions attached to the looser neighborhood structures, gall-ducts, gall-bladder and gastro-hepatic omentum.

4. When the gastric note is constantly transmitted by tuning fork *through the liver and heard above the right costal margin* (see Fig. 56), I would expect to find adhesions between the pylorus or duo-



FIG. 56

denum and the under surface of the liver. The clear distinctness of the transmitted note and its wider distribution over a larger area of the liver suggests that the adhesions are denser in character or more widespread. All of these tuning fork transmissions of the gastric note will be enhanced if 3 or 4 ounces of air are injected into the stomach.

The most likely error which enters into these deductions arises from this anatomical fact, that in patients in whom the transverse colon occupies a normal position the bell of the stethoscope, when placed in the mid-left epigastrium, will also be in topographical anatomical relationship with the transverse colon as well as with the stomach. Why, therefore, may not the transmitted tuning fork note be coming from the colon instead of the stomach? To differentiate this point it seems best to transfer the bell of the stethoscope from the left

epigastrium to a point just above and slightly lateral to the right iliac fossa so that by surface topography it is placed over the cecum or ascending colon, at which point obviously the stomach can be ruled out (see Fig. 57). If then the tuning fork note is *equally well* transmitted to the costal margin or through the liver, and is found *constant* on repeated examinations, we might expect to find the adhesions between the hepatic flexure of the colon and the liver or gall-tract quite as well as to infer that the adhesions involve the pylorus or duodenum. Much less frequently will it be found that the note is transmitted from the right iliac fossa rather than from the left epigastrium. I believe this consistent with the surgical



FIG. 57

statistics that with inflammations of the gall-tract adhesions are much more apt to form between the stomach and duodenum than between the gall-tract and the colon.

It is necessary to emphasize conspicuously one word of caution in the technic of this test. When the stem of the tuning fork is placed upon the skin surface it should be placed firmly, but at the same time with the idea of *relaxing* the skin tension by pressing toward the bell of the stethoscope and not away from it (see Fig. 57). This means that in the latter position the skin is stretched between the stem of the tuning fork and the bell of the stethoscope and the transmitted sound is conducted superficially along the taut skin

surface. It is very easy to prove that this is so by placing the bell of the stethoscope anywhere in the lower abdomen and placing the stem of the tuning fork over the liver in such a way as to stretch the skin between the two points, in which case the tuning fork note will be transmitted from any point on the abdominal surface.

It is wise to interpret the true meaning of this test in a most restricted sense until one has had sufficient experience with it, in a large series of examinations, in order to develop a greater personal sense of security in its accuracy. It will be found a useful clinical procedure in the way of further suggesting adhesions of the upper right quadrant which involve the stomach, duodenum or the hepatic flexure of the colon. The likelihood of this simple clinical test being correct will be increased if the result of the roentgen-ray examination suggests that the pyloric end of the stomach is pulled over to the right and upward, or there is found some distortion or flattening of the duodenal cap. Likewise, I have found that where this tuning fork test can be clinically considered positive for adhesions, during the making of the physical examination, as we proceed to study the case by intubating the duodenum there frequently occurs some further confirmation of its reliability in that the gastro-duodenal transit time of the duodenal tube is prolonged above its average normal limit of twenty minutes (see page 311), or its transit may be prevented.

I do not consider however, that the finding of clinical suggestions as to the presence of upper right quadrant adhesions is *necessarily* always an indication for operation *unless* the adhesions have taken form in such a way as to obstruct the free passage of bile from the common, cystic or hepatic ducts, so that it can be proved by *repeated* attempts at medical drainage of the gall-tract that this method of treatment is not applicable to that individual case since it cannot drain the gall-passages, and that, therefore, surgery must be resorted to. I take this position chiefly in view of my past experience with personal patients of mine so operated, as well as very numerous cases who have come to me following such operations, who have consented to the urgings of those who believe that adhesions *per se* should be surgically removed. In too many instances have such non-obstructive adhesions been converted into obstructive types following the use of the knife (see Report of Case XV, page 548). For the surgical genius who can work out a method of preventing postoperative adhesions, or who can operate for the release of adhesions without the danger of their reformation, will be reserved a special niche in the medical hall of fame, and he will deserve the undying gratitude of many a sufferer.

In regard to this matter of adhesions, I have for a number of years held the same feeling of resentment at the performance of a gastro-

enterostomy for the relief of a *non-obstructing* duodenal ulcer. From this it should not be inferred that I am opposed to the very useful operation of gastroenterostomy, but believe that it should be more largely limited to its best use for aiding in the correction of *obstructive* lesions which involve the pylorus or duodenum. In such cases it unquestionably gives its best results. If pyloric and



FIG. 58.—Represents patient in knee chest position for rectosigmoidoscopic instrumental examination. Note the special sigmoidoscopes and instruments designed by the author and Dr. Henry J. Bartle. (For the description of the instruments and method of use see the following papers: 1, A New Type Sigmoidoscope, *Jour. Am. Med. Assn.*, September 30, 1922, **79**, 1135. 2. Sigmoidoscopy, *New York Med. Jour. and Med. Rec.*, December 6, 1922.

duodenal ulcers require operation it should be a surgical rule wherever possible to resect the ulcer bearing area, and to do a Finney pyloroplasty if possible instead of the too prevalent gastroenterostomy. Furthermore, no treatment for gastric or duodenal ulcer, whether medical or surgical, should be undertaken before making sure of the etiological factor or factors which produced it. If the

patient is luetic treatment for this should be continued or begun. If bacterial foci are found in tonsils, teeth or gums, these should be removed before attempting either a medical or surgical cure, and whichever is used should embrace a careful follow-up plan of management for at least a year. (See Report of Case XXVIII.)

In a book of this kind it is needless for me to discuss the routine methods for determining the presence of epigastric, inguinal or femoral herniæ, of palpating for kidneys or spleen, or of examining the appendix or the pelvic organs; or to speak of such commonly known matters as determining diastases of the recti, or abnormal irregularities in the abdominal wall produced by a visible mass or visible knuckles of gut or visible peristalsis, obstructive or otherwise. Nor do I think it necessary to formally discuss the methods of digitally and instrumentally examining the anus, rectum and sigmoid, except as data from such examinations will be later brought out in the citation of case histories (see Fig. 58).

I do believe, however, that more attention should be paid to *auscultation* of the abdomen. One gains by this an additional appreciation of the amount of gas or fluid content in the intestines, which should already have been made out by palpation. By auscultation one can tell more about the condition of hypo- or hyper-peristaltic activity of the intestines than by any other method. The use of the stethoscope should be more freely encouraged in this zone of physical examination.

A word or two should be said in regard to the importance of *examining the spine and sacroiliac joints*. Not only gross alterations, such as those produced by a scoliosis, lordosis or kyphosis, or in lean subjects abnormal jammings of one spinal vertebra upon its fellow, should be observed, but also an attempt should be made to elicit tenderness over the roots of the nerves emerging from the spinal column. Often times the detection of such a definite point of spinal tenderness will give a clue to abdominal organic disease which has reflexly produced it. Such spinal tenderness can be brought out by firmly pressing both thumbs on the transverse processes of the vertebræ from the cervical region down to the lowest lumbar vertebra. Nor should the tip of the coccyx be omitted in the rectal examination. Rather than the thumbs, I prefer to use, and routinely do use, a biforked metal instrument, with a palmer handle, which fits over the spinous process and rests upon the transverse processes of each vertebra. With this held in the right hand, and firm counter-pressure made with the left hand held over the sternum, equal pressure by this instrument is made over each vertebra throughout the length of the spinal column. At this time no questions should be asked of the patient as to its effect, but one should observe each point at which the patient winces. On a second repetition of this examination the patient should be instructed to state

at which point either pain or a sense of soreness different from any other point appears, and whether it is over the left or right transverse process. These points should then be marked with a skin pencil and checked for reliability with the remembered points at which the patient visibly winced. By this means, in cases in which the gall-bladder or gall-tract is the seat of inflammation, a spinal tender point will usually be found in the right side over the fifth, sixth or seventh transverse process. This will be found positive more often in gall-tract patients who complain of right scapular

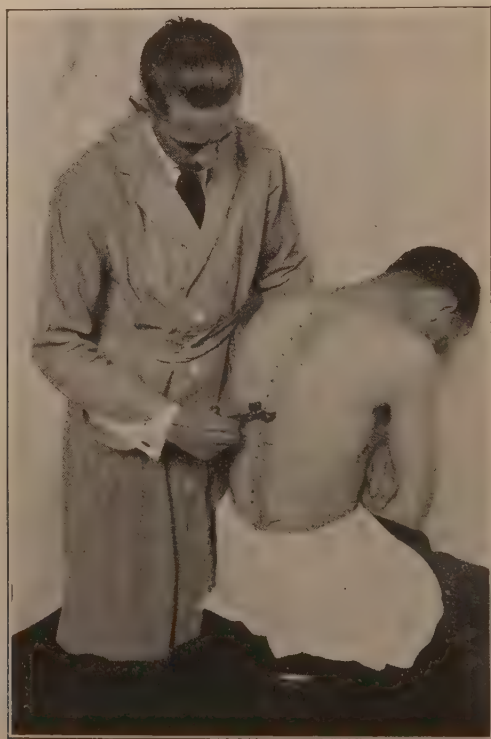


FIG. 59.—Test for spinal tenderness.

pain. The nerve route for this pain is probably through the phrenic and the supra-acromial nerves. Spinal points of tenderness for gastric ulcer will be found over the seventh, eighth and ninth thoracic vertebræ, and more commonly on the left side; in duodenal ulcer over the ninth, tenth and sometimes the eleventh thoracic vertebræ on either side, but more commonly on the right. In diseases involving the pelvic viscera spinal points of tenderness may be found over the lumbar vertebræ, more commonly the third, fourth and fifth. (See Fig. 59.)

CHAPTER XI.

DIAGNOSIS.—(CONTINUED.)

A BRIEF SUMMARY OF THE PROCEDURES OTHER THAN HISTORY AND PHYSICAL EXAMINATION WHICH ARE REQUIRED IN THE MAKING OF A DIAGNOSTIC STUDY OF THE GASTRO-INTESTINAL TRACT.

At this point, then, we have completed the diagnostic data to be obtained from a carefully conducted historical inquiry and from a complete physical examination. As has been stated above, in many cases a fairly accurate major diagnosis can be made by these two steps in diagnosis alone. But this is by no means always so in cases that are complicated and which require more intimate differential diagnosis. Nor do we ever gain by history and physical examination *all* of the direct evidence of the collateral or minor diagnoses which are so important to obtain if our program of treatment is to be made comprehensive and efficient. So much, therefore, can be gained by history and physical examination, but only so much. We must usually go further, and even after exhausting all of our differential methods of study we may occasionally find ourselves at the end of a blind trail. To always make the diagnosis by history and physical examination alone is somewhat like trying to intimately understand and digest the contents of a book by attempting to read through its cover. We can guess something from the title of the book and say from this that it must be much like another such book which we have read, but on opening it and studying its pages carefully we find that its subject-matter has been handled in an entirely different way, leading to different conclusions. So, too, with the human body. There are relatively few cases that are alike in all of their minor details.

I need, therefore, only point out that the final diagnosis of major and minor groupings is made up of a *summation* of diagnostic *impressions* obtained from the history, the physical examination and from several of the technical examinations. (See Figs. 52 to 54 and 60 to 65.) So you will notice at the bottom of the history examination form the words "Provisional (mental) Diagnosis." Here are to be entered the several diagnostic possibilities that have suggested themselves as the history or physical examination is proceeding, and it is the purpose of the further technical or laboratory studies to differentiate these possibilities. This provisional or mental diagnosis is excellent training for us all.

Acidity ^a	F	15	30	45	60	75	90	105	120	135	150	165	F	15	30	45	60	75	90	105	120	135	150	165
165																								
150																								
135																								
120																								
105																								
90																								
75																								
60																								
45																								
30																								
15																								
0																								
Total																								
Free.																								
Chyme																								
Bile																								
Mucus																								
Oc. Bl.																								
Ant. CC																								
Time	F	1/4	1/2	3/4	1 hr	1 1/4	1 1/2	1 3/4	2 hr	2 1/4	2 1/2	2 3/4	F	1/4	1/2	3/4	1 hr	1 1/4	1 1/2	1 3/4	2 hr	2 1/4	2 1/2	2 3/4

Record all quantitative estimations on scale 0, 1, 2, 3, 4.

Esoph. Obstruct.
Took tube well?
Retching,
Nervous,
Tonus,
Eating Residuum:
Evald. H₂O, Boas, Riegel,
Motor Meal hrs. before
Amount cc
Sediment
Color,
Odor,
Bile,
Mucus, Floating,
" Mixed,
Blood,

CHEMISTRY:
Lactic Acid,
Pepsin,
Pepsinogen,
Rennin,
Renninogen
Trypsin,
Bile,
Oc. Bl.-B
Oc. Bl.-G
Woff-Jungmans,
Special,
SALIVA:

MICROSCOPY:
Food Resids,
Mucous Strands,
Mucous Snails,
Epithelium,
Respiratory,
Oral,
Esophageal,
Gastric,
Duodenal,
Biliary,
R. B. C.
W. B. C.
W. B. C. Digested,
W. P. C. Bile Stained,
Bile Salts,
Crystals,

BACTERIA:
Flora, normal
Free, increased
Masses,
Colonies,
Bile Stained,
" long,
" short,
Oppler-Boas,
Cocci, chains,
" clumps,
" diplo.
Yeast,
Sarcinae,
Culture,

IMPRESSION:
Motility,
Obstruction,
Cardiospasm,
Pylorospasm,
Secretion,
Acidity,
Gastritis,
" Infective
Bleeding,
Trauma,
Congestion,
Ulceration,
Carcinoma,
" Chem.
Achyia, Psychic.
Biliary Regurg.,
Fastig.,
Digesting,

Likewise you will find on the gastric analysis chart (see Fig. 60) that the final column is reserved for the diagnostic impression, and here is to be entered the final estimate of the analysis gleaned from a study of the total chart. Finally, a diagnostic impression space will be found at two points on the biliary drainage chart (see pages 211 and 213), one concerned with the gross phenomena noted during the drainage and one to cover the microscopical and cultural study.

It is well for us to remember that in a difficult differential study that since neither the history nor the physical findings can always make the diagnosis, it certainly cannot be made from any single laboratory study unless it is unequivocally positive, and this is of comparatively infrequent occurrence. But what we do receive in the total study of the patient is a diagnostic impression from each additional procedure, and all of these steps when completed and studied and interpreted make up our final diagnostic opinion, based on the evidence collected.

It will save much time, as well as serving the convenience of the patient, if all instructions for the preparation necessary for each examination is printed in clear and concise language. This avoids much confusion and unnecessary repetition. (See Fig. 62.)

In my personal practice in the study of complicated cases, and the average patient who is *chronically* afflicted with digestive disorders falls into this grouping, I find that about fifteen hours of the patient's time must be devoted to a study of his case. These fifteen hours are divided into five appointments of three hours each, the first period of which is devoted to the taking and making of the history and physical examination. On the second visit a careful clinical study is made of the fasting and digesting stomach, particularly as regards its secretion, its motility and its microscopy. (See Fig. 60.) On the third visit the three hour period is devoted to checking up again on the fasting gastric residuum and then proceeding with a study of the duodenal, biliary and pancreatic tracts by means of a medical drainage of this zone (see Fig. 61). On the fourth visit is taken up a study of the urine and the functional elimination of the kidneys to phthalein, the usual study of the blood, and if indicated, its serology and chemistry, and a study of the gross and microscopical findings in one or more stools. (See Fig. 63.) On the fifth visit additional technical procedures are carried through when indicated, such as spinal puncture, allergy tests, examinations of sputa, saliva, of vaginal or prostatic smears, or, if necessary, a repetition of the diagnostic biliary drainage or functional hepatic tests, or a more detailed study of the nervous system. The patient's intestinal motility study (see Fig. 64) can be charted by the patient at home and brought in to the office for inspection.

BILIARY DRAINAGE REPORT

Name.

Date,

Case No.

FASTING RESIDUUM:

1. Took tube well?
2. Amount cc
3. Sediment
4. Color
5. Bile
6. Mucus
7. Free HCl
8. Total HCl
9. Oc. Bl.-B
10. Oc. Bl.-G
11. Wash clean No.
12. Astring. clean No.
13. Disinfect clean No.
14. Total glasses clean
15. Amts. recovered
16. Inflow rate mins.
17. Outflow rate mins.
18. Tonus, Good, Poor
19. Mucus, clouds
20. Mucus, floccules
21. Bile, regurgitated

MICROSCOPY:

1. Food Rests
2. Mucous Strands
3. Mucous Snails

EPITHELIUM:

1. Respiratory
2. Oral
3. Esophageal
4. Gastric
5. Duodenal
6. Biliary
7. R. B. C.
8. W. B. C.
9. W. B. C. Digested
10. W.B.C. Bile Stain'd
11. Bile Salts
12. Crystals

BACTERIA:

1. Flora, normal
2. Flora, increased
3. Free
4. Masses
5. Colonies
6. Bile stained
7. Bacilli, long
8. Bacilli, short
9. Cocci, chains
10. Cocci, clumps
11. Cocci, diplo.
12. Sarcinæ

Yeast

Cultural Identity

Record all quantitative estimations on scale 0, ?, 1, 2, 3, 4.
 FIG. 61 A.—Chart for biliary-tract drainage.

Name,	Date,								
DUODENAL EXAMINATION:									
Entrance time:									
1. Vagotonic?									
2. Antispasmodics?									
3. Duct open?									
4. Amt. in cc									
5. Duod. Washed?									
6. Mucoid									
SEDIMENT (gross):									
1. Fine feathery									
2. Granular									
3. Thick clumps									
4. Shaggy masses									
5. Bile stained									
6.									
BILE MICROSCOPY:									
A. B. C.									
CYTOLOGY:									
1. W. B. C.									
2. W. B. C. stained									
3. R. B. C.									
4.									
Epithelium:									
1. Cuboid									
2. Low Columnar									
3. High Columnar									
4. Bile stained									
5.									
Crystals:									
1. Lecithin									
2. Cholesterolin									
3. Glycocoll									
4. Pigment									
5. Bile Salts									
6.									
Mucus, clear									
Mucus, stained									
Mucus, c. salts									
BACTERIA:									
1. Flora, normal									
2. Flora, increased									
3. Free									
4. Massed									
5. Colonies									
6. Bile stained									
7. Bacilli, long									
8. Bacilli, short									
9. Cocci, chains									
10. Cocci, clumps									
11. Cocci, diplo.									
Parasites									
Cultural Identity									
IMPRESSION:									

DAILY REPORT OF BILIARY DRAINAGE.

DATE,

Transit Time
Duct open?
Occult Blood

A—BILE:

Amount cc
1. Viscosity
2. Flocculi
3. Cloudy

COLOR:

1. Lemon
2. Golden
3. Brown

B—BILE:

G. B. removed?
Amount cc

No. STIMULATIONS:

1. Free flow
2. Steady
3. Intermittent
4. Drops

COLOR:

1. Lemon
2. Golden
3. Brown
4. Green-brown
5. Green-pea
6. Green-dark

Record all quantitative estimates on scale 0, 1, 2, 3, 4.
FIG. 61 C.—Chart for biliary-tract drainage.

7. Green-black
8. Black
- 9.
- 10.

Viscosity—plus or 0

1. Turbid
2. Flocculi
3. Clear
4. Crystalline
5. Effervescence

SPECIFIC GRAVITY:

COLORIMETRY:

Green

Red

Blue

Ocult Blood

C—BILE:

Amount

COLOR:

1. Lemon

2. Golden

3. Brown

4. Turbidity

5. Clear

6. Culture

7. Disinfection

8. Duodenal Enema

9. Sodium Sulphate

IMPRESSION:

Record all quantitative estimates on scale 0, 1, 2, 3, 4.

FIG. 61 D.—Chart for biliary-tract drainage.

INSTRUCTIONS FOR PATIENT UNDERGOING A DIAGNOSTIC STUDY.

In a diagnostic study of your case, such as we are undertaking, certain things have to be done by us to find the cause of your illness. To do these things well, and to obtain the correct results, we have trained ourselves and our assistants in various methods of investigation which we have found give the least discomfort and inconvenience to the patient without lessening the value of the procedures from a diagnostic standpoint. However, much depends on the willingness and faithfulness with which you carry out the instructions, as to whether success or failure comes of our efforts. Therefore, please bear in mind that the following instructions are given for a definite purpose, and are actually what we require you strictly to do. Furthermore, do not try to memorize them, but consult them at 6 P.M. of each day while you are under study, to learn what preparation you are to make for the following visit.

1. You will be given a jar (which you will label with your name and date), a basin and two wooden blades. In the jar you will bring on morning the last stool passed by you before coming to the office. It is well to collect the stool the day before coming, and if you should have a subsequent one before starting out for this office, discard the old one, wash out the jar thoroughly, and place the latest one therein. Pass the stool directly into the basin, and with the aid of the two wooden blades place all of the stool within the jar, carefully avoiding smearing the outside of the jar, and adjust cap down snugly. Keep the jar in the coolest place you can find. Urine or menstrual discharge should not be allowed to mix with the feces, as they will cause errors in the examination. If you are given a special diet by us to follow before bringing the stool, please give this your most careful consideration, and do not eat anything that is not printed on the diet slip.

2. In one of two bottles you will bring a specimen of urine collected two hours after your heaviest meal of the day. Keep it cool.

Just before collecting this sample, the genitals are to be washed with soap and water as thoroughly as possible, so as to prevent anything except urine entering the bottle. The following morning,, at 7 A.M., please pass your urine, cleansing the parts again, and bottle a portion of it and label it "A.M." and bring both these bottles with you. Write your name on each bottle. Drink a glass of water at 7 A.M. and again at 8 A.M., but do not pass urine again until you get to the office at 8.45. You may eat your regular breakfast this day.

3. At 9 P.M. on, and again on evening, you will please eat one meat sandwich, with twenty raisins or currants, and drink a glass of water or hot milk and water mixed and sweetened. Eat or drink nothing after this either during the night or early morning until we give it to you in this office at 8.30 A.M. Do not brush your teeth, and do not swallow saliva that may form in your mouth or mucus that may be coughed up or brought down at the back of the mouth. This is very important.

4. The two red capsules in the envelope contain a dye which is intended to color one of your meals as it passes through you, so that we may be able to learn how long any one meal stays in your digestive tract. Swallow these two capsules with the *next meal after a bowel movement on* Every bowel movement after taking them is to be watched by you and recorded (see next page) in its proper column until no more red is to be seen in the stool. Have the stool passed into a pan or chamber, and examine it in a good light, and then finally pour water into the vessel to observe whether the stool floats or sinks, being sure that it is not stuck to the bottom.

PHENOSULPHONE- PHTHALEIN 1st Minutes 2d " 3d " Total,	cc	%	cc	%	cc	%	PANCREATIC ENZYMES: Trypsin, Steapsin, Amylopsin,				MOTILITY: No. of Stools, Appear. hrs. Disap. hrs. Laxatives?
SPUTUM:							SALIVA:				ALLERGY REACTIONS:

Record all quantitative estimations on scale 0, 1, 2, 3, 4.

Fig. 63 A.—Chart for further laboratory tests.

NAME,	DATE,	
	THIS REFERS TO TIME	
Description of Bowel Movements.	1st	2d
DATE and HOUR A.M. or P.M.		
COLOR —Red, brown, red and brown, yellow-brown, etc.		
FORM —Sausage, small, balls, long string, pencil, flattened ribbon, mushy, liquid.		
AMOUNT —roughly in teacupfuls, table-spoonfuls, etc.		
MUCUS —Jelly-like masses, skin-like strings, or sticky and glistening.		
UNDIGESTED FOOD — Hulls of corn, beans, peas, seeds or fruit skins.		
ODOR —Sour, putrid, pungent, very offensive.		
FLOATS OR SINKS — Completely cover with water; shake free of sticking to bottom.		
SUMMARY (Do not write on this line),	Appearance,	Hours.

HOUR		A.M.	P.M.
OF TAKING CAPSULES			
3d	4th	5th	

MOBILITY	Free	Slightly Fixed	Fixed	
FILLING DEFECTS	Cardia	Media	Antrum	
INCISURA	Present	Absent		
OUTLINE	Regular	Irregular	Projections from	
SPHINCTER.	Seen	Not Seen	Regular	Irregular
RESIDUE	Hours	None	Small	Medium
				Large
FILLING	Normal	Absent	DUODENUM	
DELAY AT	1st	2d	Irregular	
POSITION	Normal	Oblique	High	Low
TENDER POINTS	Present	Absent		
POSITION	Normal	High	ILEUM	
MOBILITY	Free	Slightly Fixed	Low	Kinked
RESIDUE	At hours			

FIG. 65 B.

HEAD OF BISMUTH COLUMN, Ileum							
FILLING	MOBILITY	TENDER POINTS	RESIDUE	Cecum	Hepatic	Trans.	Rectum
.					CECUM		
Normal	Free	Present	At hours	Absent	Irregular		
				Slightly Fixed	Fixed		
				Absent			
				APPENDIX			
FILLING	MOBILITY	POSITION	TENDERNESS	Not Seen	Complete	Partial	
.							
Seen	Free	Normal	Present	Slightly Fixed	Fixed		
				High	Low	Right	Left
				Absent			Kinked
				COLON			
FILLING	POSITION	FIXED AREAS		Irregular at	Ascending	Trans.	Rectum
.						Descending	
Normal	Normal	Absent		High	Low	Left	Kinked
				Present at			

REMARKS: Heart
Chest
Lungs

Gall-bladder
Calculi

Genito-urinary Tract

FIG. 65 D.

it is understood that history and physical examination are fundamental in every case and must be done: Physical examination consists of (1) inspection, (2) palpation, (3) percussion, (4) auscultation, and (5) mensuration, and hereafter will be referred to by their numbers only. Bacteriology is coded as B, chemistry as C and microscopy as M.

BEST DIAGNOSTIC EVIDENCE OBTAINED BY	BEST DIAGNOSTIC EVIDENCE OBTAINED BY	SECONDARY DIAGNOSTIC EVIDENCE OBTAINED BY
Ear: P. Ex.: 1, 2, 3, 4. B.	Roentgen-ray.	Gross inspection.
Mastoid: P. Ex.: 2, 3. Catheterization.	Sound transmission.	Perimetry.
Eustachian:	Bárány tests (?)	Color blindness.
Sinuses: P. Ex.: 1, 2 and 3. Roentgen-ray.	Transillumination.	Goetsch adrenalin test.
Nasal Cavity:	Operation (?)	Metabolism. Therapeutic tests.
Larynx: Laryngoscopy.	Roentgen-ray.	Blood-pressure.
Trachea: } Bronchi: } Bronchoscopy.	Sputum: B. and M.	Functional tests. Blood pressure.
Lungs: P. Ex.: 1, 2, 3, 4 and 5.	History.	Electrocardiogram.
Sputum: B. and M.	Paracentesis.	
Roentgen-ray.	Metabolism (?)	Roentgen-ray.
Diaphragm: Roentgen-ray.	Litten's sign: P. Ex.: 1, 2, 3, 4.	Metabolic and blood studies. B.
Kidney: Urinalysis: B., C. and M.	P. Ex.: 2.	P. Ex.: 1 and 2.
Roentgen-ray: a. pyelography, b. calculi.	Functional tests: a. colorimetry, b. diet.	
Pelvic catheterization.	Blood chemistry.	Urethroscopy. Cystoscopy. Urinalysis.
Animal inoculations.	History. P. Ex.: 2.	B. and M.
Ureters: Catheterization.	P. Ex.: 2 and 3.	
Roentgen-ray: a. calculi, b. Diet's.	Urinalysis: B., C. and M.	
Bladder: Cystoscopy.	History. Psychoanalysis. Blood serology.	
Roentgen-ray for calculi.	Goetsch adrenalin test. Therapeutic tests. Metabolic studies (?)	
Nervous System:		
P. Ex.: Special tests.		
Spinal fluid.		
Endocrines: History and P. Ex.		

FIG. 67.—Represents a schematic outline of the methods recommended by the author of securing diagnostic evidence concerning various organs and vital functions aside from the gastro-intestinal tract. The left hand column illustrates the procedures which will furnish the best diagnostic evidence for each organ or vital function, and the right hand column the methods that will yield secondary diagnostic evidence.

So in a complete diagnosis this fifteen hours of the patient's time runs into approximately thirty hours of office time, inasmuch as this much more is required to get ready for the technical studies, to continue the examinations after the patient has gone, to clean up the necessary equipment, and to study the various diagnostic data that are being assembled. In addition to this a certain number of cases must be sent for dental or ocular examinations to other doctors, and for complete roentgen-ray study of the gastro-intestinal tract, or other systems, to the most capable roentgenologist *trained* to an interpretation of gastro-intestinal problems, who has proved himself a good coöperative diagnostician.

While I believe that every office devoting its time to clinical gastro-enterology should be equipped with fluoroscopic roentgen-ray apparatus which will be found of great value in short-cutting certain parts of the work, nevertheless I prefer my roentgen-ray plate work to be done and interpreted by a roentgenologist who is devoting his entire time to this field and who maintains a laboratory that is equipped in every detail. It is possible with such a man to draw up a chart (see Fig. 65) to cover the gastro-enterological roentgen-ray findings, which will be mutually useful and will include the specific points which the clinician particularly desires. After ten years of such coöperative work with Professor Willis F. Manges, in charge of the Roentgen-ray Department of Jefferson Hospital, Philadelphia, I have no cause to regret this method of procedure.

That such a routine method of differential diagnosis is laborious and time consuming is not to be gainsaid, but it brings with it its reward in a sense of work well done and in the end brings greater profit to the patient in the restoration of his health, which, after all, is the prime reason for our engaging in medical practice. Unless all parts of such a diagnostic frame work are comprehensively and intelligently carried through, the whole structure of sound diagnosis fall apart. Indeed I know of no more dangerous fallacy than for a doctor to send a patient to a gastro-intestinal specialist for a simple gastric analysis, or a diagnostic drainage of the bile tract alone, or for a stool examination, and ask this specialist to base an opinion on this single fragmentary aspect of the case. Such an opinion is not worth the asking and, as a rule, the patient gains nothing from such work.

Similarly, I believe that to send a patient directly to roentgen-ray examination before a thorough clinical survey has been made is putting the cart before the horse. It throws too great a responsibility on the roentgen ray as a primary diagnostic maneuver. In certain cases it measures up to this, notably in chronic appendicitis or in visualized gall-stones. Too often, however, it serves

only to focalize attention on the major diagnostic possibility, but without differentiating the details which can better be brought out by careful clinical survey. Nor can it bring out the collateral or minor diagnostic groupings which are often a determining factor in the proper management of the case.

I prefer, therefore, to use roentgen-ray plate diagnosis as a confirmatory or check-up method added to a careful clinical study. I have had two reasons for this: First, because it stimulates personal industry and accuracy in securing detailed diagnostic data, to avoid the humiliation of suffering a diagnostic defeat at the hands of the roentgenologist. Second, because it reduces the total expense incurred by the patient, which is a point to be borne in mind in every-day practice.

CHAPTER XII.

DIAGNOSIS.—(CONTINUED.)

A BRIEF HISTORY OF THE DEVELOPMENT AND EVOLUTION OF GASTRIC INSTRUMENTS AND METHODS OF DIAGNOSIS AND TREATMENT.

THE discovery or invention of the stomach tube and its first practical use was achieved by an American physician, Philip A. Physick, (12) Professor of Surgery in the University of Pennsylvania, who published his original paper in October, 1812.

From the historical survey of the subject by Julius Friedenwald, of Baltimore, presented before the Johns Hopkins Historical Club, March 9, 1903, it is evident that Physick had devised and used his stomach tube as early as 1800, but he very generously acknowledged that the credit for his invention should be given to Dr. Alexander Monro, Jr., of Edinburgh, who suggested the idea to him in 1797.

Physick's published account of his tube was not known in Europe and for a time credit for this invention was given to two English surgeons, Jukes and Bush, the former of whom published the description of his tube in the *London Medical Repository* in 1822, twenty-two years after Physick had designed and made the first practical use of his apparatus. One of these early instruments is illustrated in the photograph on page 229 which indicates that it met with some immediate favor.

During this early period the use of the stomach tube was confined to the removal of various poisons from the stomach in human beings and for extracting gases and food from the fermenting stomachs of cattle. No further epoch in tube work was then reached until Kussmaul, a Director of the Friburg Medical Clinic, on July 22, 1867, first made use of the stomach tube as an instrument for treating gastric pathology and later conceived of its possibilities as a diagnostic instrument. Kussmaul realized that, while helpful in relieving gastric distress by removal of stagnating contents, and while it might cure cases of gastric dilatation by lavage, the stomach tube had very limited possibilities in the removal of real pathology. His work stimulated Billroth a few years later to attempt the cure of advanced gastric diseases by surgical procedures.

In 1871, von Leube further developed the use of the stomach tube as a diagnostic instrument, but the stiff rubber tubes then in



FIG. 68.—(Reproduced through the courtesy of Dr. Julius Friedenwald.)

vogue were cumbersome and further progress was not made until Ewald and Osler introduced the soft rubber stomach tube (of large caliber) in 1875.

Prior to the beginning of the nineteenth century medical interest in the digestive tract, beyond comparatively casual speculation, was very meagre. Most of the real work done on this subject is modern history, little more than a century old, and by far the greater amount of it falls within a period of the last fifty years.

Nevertheless, if one reviews the gradual development of the first method of gastric analysis and the various evolutions through which it has passed, starting from the praiseworthy, but cumbersome, efforts of the early pioneers in this field and tracing it down to the more refined, exact, and withal more simple methods in use today, one cannot fail to be impressed by the tremendous amount of industry which has been devoted to this subject.

Although Reaumur, Spallanzani, Stevens, Tiedemann, Gmelin and Prout had all previously made certain contributions in regard to the chemistry of the gastric juice it is likely that modern interest in this field was initiated by the patient, laborious and accurate studies which William Beaumont made (over a period of many years) on materials collected through a gastric fistula from the young French-Canadian, Alexis St. Martin.

On June 6, 1822, at Fort Mackinac, Michigan, St. Martin received an accidental gunshot wound of the left abdomen and chest, partly eviscerating him. He was attended by Surgeon Beaumont, of the United States Army, and unexpectedly recovered from his wound, although he bore a persistent gastric fistula until his death in 1880, fifty-eight years later. Beaumont began the first of his 238 experiments on St. Martin in 1825 and laid the foundations for much of our present knowledge of the physiology of the stomach.

Beaumont's 280 page monograph entitled "Experiments and Observations on the Gastric Juice and the Physiology of Digestion" was published by F. P. Allen in Plattsburg in 1833. This book attracted world wide interest. So accurate were Beaumont's observations that most of his conclusions were not materially altered by the next epoch-making studies (on laboratory animals) by the Russian experimenter I. P. Pavlov, who published "The Work of the Digestive Glands" (Griffith & Co., London) in 1895.

Sir William Osler (10) refers to Beaumont as "The pioneer physiologist of this country." It is apropos to remember that the warning sounded by Osler of "Preserve us from the doctor who draws conclusions from the reporting of a single case," is not to be interpreted in its strictly literal sense, nor did Sir William intend it to be so taken.

His attitude then is no different from that of today in a feeling

of resentment against the tendency so common then and now, of men by no means qualified to speak, who waste valuable time at important medical meetings, or who consume valuable space in our medical journals in the simple recitation of a few isolated cases very insufficiently studied, and then attempt to draw too sweeping conclusions from their work.

Beaumont taught us that a thorough and conscientious study of any single case conducted in the light of knowledge current to the time will often prove more valuable than a recounting of a score of similar cases which have been seen, but by no means carefully studied. Those patients of today who are afflicted with a serious disease of the stomach may well give thanks that the case of Alexis St. Martin fell into the hands of a man like Beaumont who was ready to meet his opportunity. From that day to the present investigative work on this subject has gone steadily forward.

Dating from the introduction of the stomach tube into clinical medicine by Kussmaul in 1867, there developed a great outburst of interest in digestive physiology, pathology and chemistry, and during the last quarter of the nineteenth and the opening of the twentieth centuries, important contributions were made by Pavlov, Boldyreff, Heidenhain, Ewald, Riegel, Boas, v. Leube, Lenhartz, Strauss, Uffelman, Jaworski, Lütke, Martius, Volhard, Günzburg, Töpfer, Hammerschlag, Mett, Sahli, Mintz, v. Mering, Matthieu, Rémond, Schuele, Tuchendler, Hayem, Bouget, Bjorbjarg, Ehrmann, Ehrenreich, Skaller, Wolff, Cohnheim and others. These names are all well known to the present students of gastro-enterology as clinicians, experimenters, physiologists, pathologists, chemists and laboratory workers.

Various test meals were advocated by Ewald, Boas, Riegel, v. Leube and other early clinical pioneers in this field. Ewald's meal was primarily designed as a secretory test meal to be taken out at forty-five or sixty minutes after its ingestion, in a single extraction, by means of the large stomach tube. The test meals of Riegel and of v. Leube were designed to combine tests for motor and secretory function of the stomach, and were removed at periods of from four to seven hours after being eaten. The oatmeal test breakfast of Boas was intended to provide a lactic acid free food which could be made of differential use in the study of suspected cases of gastric cancer. The rationale and description of these various test meals may be found in any standard monograph on diseases of the stomach.

The next important forward step came with the work of Schuele (14) who realized that an accurate study of gastric secretory response required serial or fractional observations over a period of one or more hours, rather than single isolated observations. He proceeded to accomplish this by securing specimens of gastric chyme from a

rubber catheter which he left in the stomach throughout a large period of the digestive cycle. He plotted out the first secretory curves of the stomach—a specimen chart can be found in Sahli's *Diagnostic Methods* (Saunders & Co., Philadelphia, 1905), on page 389.

Soon it was realized that in order to proceed further with the study of gastro-enterology methods must be devised of *intubating the duodenum* and thereby gain a direct knowledge of the human physiology of this zone, in order to confirm the laboratory studies of a group of physiologists who were interesting themselves in this subject. During the waning years of the nineteenth century and the early years of the twentieth much thought and effort was directed to accomplishing and perfecting this epoch-making advance, which, in practical importance, stands side by side, with the invention of the stomach tube by Physick.

To us, a quarter of a century later, this now seems an absurdly easy thing to have done; and, as in the case of the stomach tube, after duodenal intubation was an accomplished fact and fluids from the duodeno-biliary zone could be secured, a lapse of ten or fifteen years occurred before anyone seemed to know just what to do with the materials extracted.

Nevertheless, in this present period in which we think we know so much, it is well for us to acknowledge, with gratefulness, the earnest pioneer efforts which make our own work seem now so comparatively simple; and it is also well for us to maintain a most humble spirit and mode of expression lest the forthcoming medical generations will hold us up to friendly derision for our own shortcomings. Let us remember that the history of medicine is a lasting monument testifying to the unselfish effort and unswerving devotion to duty of a host of real workers through whose *combined* efforts the multiple secrets and riddles of the human body are gradually being solved. In all controversies regarding priority of achievement we should content ourselves by realizing that there is enough honor for all who assist, even ever so little, in furthering our common cause.

The earliest pioneer work of successfully intubating the duodenum was accomplished by Hemmeter (4) of Baltimore, who published in April, 1895, his first reports of a crude device consisting of an inflatable rubber balloon attached to the end of the stomach tube, "which had a guide at the lesser curvature through which the duodenal tube glided." Hemmeter's work was soon followed by that of F. Kuhn (7) who had devised an equally cumbersome instrument consisting of a "very flexible thin steel spiral tube which was pushed through a thin stomach tube." Kuhn in turn was followed by Fenton B. Turck, who, in 1898, succeeded in entering the

duodenum by a simple, small calibered rubber tube (quoted by Hemmeter, "The History of the Discovery of Duodenal Intubation," *New York Medical Record*, February 26, 1921).

It was fourteen years later that Max Einhorn developed the first of the present modern duodenal tubes fitted with a metal tip. He reported his apparatus in the *New York Medical Record*, October 9, 1909. About sixty days later Maurice Gross (3) published a description of his duodenal tube. Hemmeter (4) states that "It is evident from the publication of Maurice Gross that in May, 1909, he had used a duodenal tube in the Out-door Department of the Roosevelt Hospital in New York, and in September, 1909, that he succeeded in obtaining duodenal contents. The testimony of Drs. W. G. Lyle and Eleanor Parry, and M. G. MacNevin, bear him out in this claim, but on January 8, 1910, Maurice Gross (3) published his first article on that subject. At that time Einhorn had not yet published his article on the duodenal tube of his design.

"Gross sought to facilitate the passage of the tube through the pylorus by gravity, for he placed the patient on the right side and weighted the end of the tube with a little ball, which was the first design of this kind."

To all of these pioneer workers too great credit cannot be given. Perhaps to Einhorn, who throughout his life has shown an especial genius in the construction and perfecting of numerous technical gastric instruments, should be given the major credit for the first attempts to scientifically study the physiology of the duodenum, the pancreas and the gall-tract by means of the duodenal tube.

Recently various modifications of the duodenal tube have been gradually developed, although no very striking changes have been made. Most of the alterations have been more concerned with the metal tip and the use of glass cannulas or observation windows instead of the older metal and hard rubber connections. Jutte, (5) who devised his excellent and simple small calibered duodenal tube which can be introduced by means of a stilette, deserves the greatest credit in teaching us some of the advantages to be therapeutically derived from transduodenal lavage. While his tube and tip are eminently practical for this purpose, it is not so well adapted for the purpose of diagnosis, particularly as regards the bile tract, due to the difficulties in extracting mucopus floccules through the very small eyelets in the rubber tube.

In chronological order special duodenal tips have been devised by I. O. Palefski, (11) who believes that a heavier weight globular tip will pass into the duodenum more rapidly; M. E. Reh fuss, (13) who introduced a slotted tip. Jacob Buckstein, (1) in order to obviate a possibility of traumatic damage to the mucosa of the duodenum from contact with a metal tip for two to three weeks during a course

of duodenal feeding, introduced a modification consisting of a light weight tip which could be fastened to the duodenal tube by catgut. After a few days the catgut stitch would be absorbed and the tip would become detached from the tube and pass out through the intestine to be recovered in the stool. This modification is useful for such cases requiring duodenal feeding or duodenal medication over a consecutive period of two or three weeks.

The Lyon (9) tip (see page 302) combines the advantages of several others. It is practically of the same weight as Palefski's and makes use of the slotted openings suggested by Rehfuß, but adds a perforation at the distal end of the tip. More important, however, it is pear shaped, rather than oval, and is therefore much easier to withdraw without impinging uncomfortably at the glottis. Its shank is elongated and serrated, thereby doing away with the necessity of tying in the tip with surgeon's silk. A. J. Levin (8) advocates the use of a tipless gastro-duodenal catheter which he prefers to introduce through the nares and claims certain advantages which are not of great practical value; L. W. Kohn (6) speaks of having devised a gastro-duodenal tube carrying a balloon to isolate the stomach and duodenum. Through the independent efforts of Einhorn and of Arthur F. Chace there has been developed a duodenal tube capable of simultaneously studying gastric and duodenal secretions. Still more recently Jacob Buckstein (1) and Einhorn (2) published their descriptions of a so-called intestinal tube designed to study lower intestinal levels. This work, though offering ultimate possibilities for great usefulness, is so recent as to be still *sub judice* and cannot be discussed in this book.

Every worker in gastro-enterology should have occasion from time to time to make use of all of these various modifications in tips, for some are more useful in certain cases than others. Many of these tips are illustrated in Fig. 98 on page 295.

Throughout the past twenty-five years vitally important contributions to the subject have been made by pioneer workers in roentgenology, such as Baetjer, Case, Pancoast, Carman, Pfahler, Cole, George, Leonard, Mills and Manges, and by a group of physiologists, among whom should be mentioned Bayliss, Starling, Carlson, Cannon, and Alvarez. The information obtained from such experimental endeavor during this period has been put to confirmation through the investigative efforts of full time experimental or operating surgeons whose especial efforts have increased our knowledge of living pathology.

The most recent important stage in this brief history was reached when Rehfuß and his co-workers (Hawk, Bergeim, Clark and Fowler) in 1914 revived the fractional method of gastric analysis first used by Schuele in 1895, and by adapting the use of the duodenal

tube to the purpose of studying gastric secretion made further contributions of lasting importance.

Among immediate American contemporaries, not previously mentioned, who have made important contributions to the subject should be mentioned Bassler, Stockton, Lockwood, Kemp, Niles, Austin and Aaron, who have published monographs on Diseases of the Stomach; and T. Brown, Friedenwald, Smithies, White, Sippy, Sailer, Cheney, Riesman, Satterlee, Draper, Cotton, Basch, Pope and others who have contributed important articles to the current medical journals or to various systems of medicine.

For a clinical study of the stomach to yield information from a gastric analysis which will compensate for the expenditure of time, it is not only necessary that the method of performing such an analysis should be planned with the knowledge of what should be expected from it, but that it should be accurately performed. There have been a great many methods suggested for the performance of a gastric analysis, each one of which has a certain degree of soundness. After having become familiar with the principles involved in the use of any method it does not matter to any great extent which one a given worker adopts so long as he standardizes the method so that in his work it is consistently applied to the study of all cases, for it is only by such a comparison of results with relatively normal and various pathological states of gastric function or disease that one learns to make deductions that are of diagnostic importance, or that in a collective way will gradually provide reliable statistics.

Fifteen years ago it was a source of much personal confusion when I consulted all of the standard monographs on the stomach and found the many discrepancies in the description of the so-called Ewald test breakfast. These differences ranged between 30 and 70 gm. of bread and 200 to 500 cc of water, and it was not until 1914 that I was personally taught by Ewald that his standard meal consists of 50 gm. of bread or roll and 350 cc of water. Since then I have consistently used these amounts in studying the secretory gastric response. Objection is theoretically made to such a meal on the grounds that it is non-palatable and does not develop psychic secretion, and for this reason various other secretory meals of tea, sweetened or unsweetened, toast, buttered or unbuttered, sweetened crackers, and so on, have from time to time been introduced. One might perfectly well adopt any such secretory meal, but after he has found the one whose interpretation he best understands, thereafter, for routine purposes, he should continue its use. So, too, in regard to any motor meal designed for either four, seven or twelve hour extraction.

For quickly determining the presence or absence of gross pyloric

obstruction I prefer to use a meal consisting of a meat sandwich, with either 6 stewed prunes or 20 raw raisins taken twelve hours before the fasting residuum is studied, and the secretory meal is given. I do not doubt that the rice or spinach meals are equally good for this purpose, but I personally rarely use them. The method which I am presenting in the next chapter, and which I believe combines the greatest amount of clinical information, consists of a twelve-hour motor meal followed by an Ewald secretory test meal, which, by fractional withdrawal (the amounts of which are recorded), plus a final test lavage to make sure that the stomach is definitely empty, adds a definite and easily interpretable motor element to an essentially secretory test meal.

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CHAPTER XIII.

DIAGNOSIS.—(CONTINUED.)

THE GASTRIC ANALYSIS.

I SHALL endeavor to present in detail a practical, clinical method of performing a fractional gastric analysis and also to reëmphasize the statements of other writers that the estimation of the acid values is the least important of the many points that can be learned from such an examination when intelligently conducted. I wish particularly to stress a few points which to me seem important, and to amplify certain microscopical observations which are helpful in arriving at a diagnosis. The method to be outlined I have found practical for both dispensary and private practice, and the information obtained has amply repaid me for the large amount of time consumed in securing detailed facts.

No two fractional charts can be compared unless they have both been done under identical conditions and the same points noted for each, and the obvious advantages of a standard technic are seen when an attempt is being made to analyze the deviations from normal in any given chart. This is even of greater importance when two charts from the same patient are being analyzed. I also wish to emphasize the need of investigation into the associated findings of the stomach, other than the acid values. These include the presence of mucus and bile, and the addition of pathological products, such as bacteria, pus, blood and tissue juices. These associated findings all have a direct influence on the interpretation of the acid curves and also yield much information as to the intra-gastric and extragastric pathology.

I will not enter here into a discussion of the relative merits of fractional analysis versus the single extraction method, other than to say that I agree with Best (1), who says, "The advantage of these curves in their superiority over the older one sample test is comparable to the advantage of the moving picture over a single snapshot."

It has only been since 1914 that fractional gastric analysis has been in general use. At that time Rehfuß (6) revived the fractional method and gave it a fresh impetus by using the small sized tube with metal tip. In this and subsequent papers this investigator laid down certain fundamental principles of fractional analysis to

which subsequent writers have been able to add little of vital importance. So-called normals, as well as abnormals, were studied by Rehfuess and Hawk, Best, Rutz and others to determine a normal curve and institute a standard. But since the type of normal curve could *not* be stabilized, other investigations took place involving the enzyme action of gastric and duodenal juices, together with microscopical observations of fasting and digesting stomach contents.

The fractional analysis method is simple and sane, and is a method not only of choice but one of necessity where gastric function is to be studied. It gives you the acid values of the contents of the stomach at any time you may care to estimate them. Errors of secretion and motility of either the fasting or the digesting stomach can be observed. The time of duodenal reflex can be checked up and matched with the appearance of blood, pus, or duodenal exfoliation in the stomach; a strong confirmatory observation in suspected duodenal ulcer, if they should be coincidental. The time of mucoid impregnation of the contents can be estimated, and microscopical examination can be made of the fasting and digesting residues.

METHOD OF ANALYSIS.

Each patient is given the following printed instructions preparatory to presenting himself for a gastric analysis:

"At 9 P.M., on _____, and again on _____ evening, you will please eat one meat sandwich, with twenty raisins or currants, and drink a glass of water. Eat or drink nothing after this either during the night or early morning until we give it to you in this office at 8.30 A.M. Do not brush your teeth, and do not swallow saliva that may form in your mouth or mucus that may be coughed up or brought down at the back of the mouth. This is very important."

This motor meal is to be taken twelve hours before the test is to be started, the principal object of the long fast being to have the stomach empty so as to get a true picture of both the acidity and microscopy of the interdigestive stomach. The purpose in not brushing the teeth is to avoid trauma to the gums with the subsequent misinterpretation of the swallowed blood when found in the stomach. The patient is warned against swallowing post-nasal discharge and bronchial excretion during his waking state.

When the patient presents himself a small sized gastro-intestinal tube, with any one of the various metal tips, is passed into the stomach. Note is made of the way the patient takes the tube, whether quietly or with retching, and to what extent the gag reflex is manifested (vagotonia versus sympatheticotonia) and evidence

of cardiospasm is watched for. The entire contents of the stomach should be gently lifted out and saved for subsequent examination. The patient is then instructed to place the tube on one side of the throat bringing it out into the buccal space behind the last molar, and in this position he will find that it interferes very little with his comfort in eating the test meal. I believe this a better plan than passing the tube through the nostril.

In the selection of a test meal I agree with Rehfuess, (6) who says, "A fixed test load, simple and accessible, readily withdrawn, and capable of showing both secretory and motor variations, as well as pathological products, is a *sine qua non* as the basis of intelligent analysis of the stomach," and I have used the Ewald meal of 50 gm. of white bread or roll and 350 cc of water (see page 235.) Approximately 50 gm. of bread is represented by 2 half-inch slices of white bread, 3 inches by 3 inches, with the crust cut off.

From the time of the last swallow of bread and water until the tube is finally removed at the completion of the test, the patient is instructed to *expectorate the saliva* into a receptacle. The object is twofold; first, to prevent its obscuring the analysis by mechanical interference, and by lowering the acid curve; and second, by recording its amount, an added bit of information is obtained relative to vagotonia (hyperptyalism) and enzyme activity can be estimated. More attention should be paid to salivary examinations.

Fifteen minute extractions are now made over an average period of two hours, making 8 extractions in all. The first 7 of these are not to exceed 10 cc each, and each amount is to be measured and recorded, but at the two hour extraction the stomach is *entirely* emptied and the amount recovered is to be measured and recorded. The material from each extraction is filtered through gauze or linen, and the filter then tested for starch with iodine solution. In this way the point at which the stomach becomes empty can readily be determined. If the stomach does empty before the two hour period an attempt should be made to continue the extraction of gastric secretion to the end of the two hour test, as much additional information may thus be obtained. When the stomach is emptied at two hours it is then lavaged with 250 cc of water to *prove* not only that it is empty of the fluid part of the meal, but also that it is empty of bread crumbs which may remain in dependent portions or in gastric crypts. The tube is then removed.

This portion of the test being completed the collected material is examined *immediately*, if possible. This point is of importance, since evaporation of the samples increases their acidity, and the continuation of digestion changes the relation of free and combined hydrochloric acid. Each sample is examined grossly for amount, chyme, mucus and bile, and chemically for free hydrochloric acid,

total acid and occult blood. The *fasting* stomach content should always be examined microscopically. In testing for acid 1 cc of filtrate is titrated against $\frac{1}{100}$ normal sodium hydroxide, of which the number of cc is multiplied by 10, giving the degrees of acidity for each 100 cc of gastric contents. The actual acidity due to hydrochloric acid can be readily computed by multiplying these figures by 0.00365. Dimethyldiamidoazobenzol and phenolphthalein are used as indicators. In testing for occult blood either a freshly prepared solution of benzidene or the commercial occult blood tablets are to be used. Rutz (8) has shown that hematin granules have a tendency to adhere to other particles in suspension and that, therefore, the *sediment* gives a more delicate reaction.

With the figures obtained from the titrations a graphic chart, of the changes in acidity is constructed, using the degrees of acidity as ordinate and time as abscissa, and making thirty minutes the equivalent of 30°. The total amount of material withdrawn is computed and this is subtracted from the 350 cc of fluid originally given, and therefore the amount that has passed the pylorus can be noted and a *clinical estimation of gastric motility is thus obtained*.

I might refer here to a further procedure that I advanced in 1915 (4) of obtaining the contents of the stomach crypts. The mouth and throat are rinsed and gargled with an astringent mouth wash (liquor zinc formaldehyde)* followed by a 1 gr. to the ounce aqueous solution of potassium permanganate, and again with sterile water. The sterile tube is then introduced, and the fasting residuum aspirated and the stomach is washed with 250 cc of sterile water at body temperature run in the tube through a glass container elevated about two feet above the patient's mouth, and immediately siphoned to a 250 cc graduate on the floor. The inflow and outflow durations are recorded, inasmuch as I feel that this gives certain clinical data relative to the state of tonicity of the gastric wall. Repeated washing is done until the return is crystal clear, and unless there is marked gross retention this is usually accomplished in from two to three washings. Then 250 cc of a 10 per cent solution of "Zincloform" is run in and allowed to remain for one minute, when it is siphoned off. This acts as an astringent and causes the mucous membrane to contract, and the secretions in the ducts are forced out and appear as floccules in the subsequent washings. These floccules are pipetted out of the solution and examined microscopically, or the complete sediment may be collected and run through a hardening process, mounted in celloidin and sectioned and stained and examined by microscope, just as any pathological specimen is handled.

* This is the same preparation as "Zincloform" (see page 301 for formula).

An even better way of collecting the flocculi is to introduce into the stomach by means of a syringe with a close fitting asbestos plunger a smaller amount (100 to 150 cc) of the astringent solution and gently aspirate and force it back again into the stomach perhaps a dozen times.

After the first several re-aspirations it can be usually observed that the lavage water, which was at first macroscopically clear, becomes gradually turbid and contains variously-sized flocculent bodies, ranging from pin-point to 3 to 5 mm. in size. During this period of aspiration and re-injection a stethoscope should be applied to the abdominal wall in the gastric area, and the size, shape, and position of the stomach can be readily mapped out by determining the maximum lines of intensity of the auscultatory tinkling and bubbling sounds. After thus douching the gastric mucosa, all of the fluid is aspirated from the stomach and then a small portion tested for occult blood and the remainder mixed with equal parts of a 10 per cent solution of formalin. This latter will serve as a quick method for securing material for fresh microscopical cytology and will preserve the cells for several hours.

The residual gastric contents or material aspirated from the stomach is recorded in cubic centimeters, allowed to filter, and the filtrate tested for its acidity to determine hyperacid states; the filter paper is then punctured and the residue washed into a clean bottle with the 10 per cent formalin solution, and both specimens, properly labeled, are then sent to the laboratory to be handled in the following way:

Technic of Preparing Sediments for Staining.—1. Add to gastric washings an equal quantity of 10 per cent formalin and allow to stand for at least three hours.

2. Filter through a smooth filter paper. After filtration wash the sediment down to the tip of the filter paper by means of a wash bottle.

3. Cut off the tip of the filter paper containing the sediment. Fold the paper to prevent the escape of the sediment. Wrap the paper in one layer of gauze; tie it fast with a thread.

4. Place in acetone I for one hour.
5. Place in acetone II for one hour.
6. Place in acetone III for two hours.
7. Place in paraffin and chloroform, each one hour.
8. Place in paraffin (M. P., 52° C.), each one hour.
9. Place in paraffin (M. P., 52° C.), each two hours.
10. Imbed in paraffin.

(a) Attach to a block of vulcanized fiber by means of melted paraffin a piece of cardboard, 6 x 12 x 2 mm.

- (b) Unfold the filter paper and remove the sediment. Mould it into a small block and attach to the pasteboard with melted paraffin.
 - (c) Wrap around the block a piece of paper 25 mm. wide, previously dipped in paraffin.
 - (d) Float block in iced water and fill the paper box with melted paraffin (M. P., 52° C.).
 - (e) Trim the paraffin down to the plane of sediment.
11. Cut serial sections.
 12. Float the sections on warm water and place them on slides previously covered with a thin layer of Meyer's egg albumen.
 13. Wipe off the excess of water from the edges of the slides.
 14. Place the sections in a dry heat sterilizer, at 70° to 80° C., for thirty minutes or until sections are perfectly dry.
 - Staining.*—15. Place sections in xylol (in Coplin's jars) for five to ten minutes to remove paraffin.
 16. Place sections in absolute alcohol for five minutes.
 17. Place sections in 95 per cent alcohol for five minutes.
 18. Place sections in 80 per cent alcohol for five minutes.
 19. Place sections in water for five minutes.
 20. Place sections in hematoxylin for five minutes.
 21. Place sections under a slow stream of running water until they turn blue.
 22. Place sections in a weak aqueous solution (about 1 per cent) of eosin.
 23. Place sections in 80 per cent alcohol for a few seconds.
 24. Place sections in 95 per cent alcohol for a few seconds.
 25. Place sections in absolute alcohol for a few seconds.
 26. Place sections in xylol for ten or more minutes (to clear).
 27. Mount in balsam.

This method has proved of great help to me in keeping *permanent* records of intragastric pathology.

Normally, in the slides from the aspirated fasting residue one finds occasional epithelial cells; occasional leukocytes with protoplasm intact in those cases in which chemical titration shows faintly acid or neutral or slightly alkaline reaction. Boas and Paul Cohnheim have pointed out that digested protoplasm of epithelium or leukocytes indicates the presence of free hydrochloric acid and pepsin. When the protoplasm of the epithelial cells is still intact it is possible to differentiate endogenous gastric cells and those originating from the mouth, pharynx, respiratory track, and esophagus. Normally, one frequently encounters the snail-like bodies, first described by Jaworski, (3) which Boas and Paul Cohnheim believe to be mucus, which have been acted upon by hydrochloric acid.

Pathologically in the fasting morning stomach one may find remnants of food eaten the night before, such as muscle fibers still striated or partially digested; starch granules; vegetable cells; seeds from berries, any of which from the twelve-hour fasting stomach is indicative of motor insufficiency, due either to pyloric obstruction or rarely to advanced atony. Associated with this, if one finds sarcinæ in numbers or many yeast cells in process of germination it would suggest gastric dilatation with stagnation and fermentation. Sarcinæ are rarely found in the ectasia of cancer, except the ulcer carcinomatosum type. It should be remembered that small amounts of food remnants are not significantly pathological (cryptic mucosæ and cavities in teeth). If there has been regurgitation from the duodenum there may be crystals of some of the bile salts.

Paul Cohnheim attaches importance to infusoria like *Trichomonas hominis* and *Megastoma entericum*, and believes they are associated with cancer when the motility of the stomach is not affected. Personally, I have never encountered them. They require for their development an absence of hydrochloric acid, an alkaline medium, and a cryptic mucosa. Mucus from the respiratory tract will float, owing to its air content. Microscopically, it is characterized by containing alveolar cells and myelin drops, while columnar epithelium indicates its derivation from the gastric mucous membrane. Also, in gastric dilatation one occasionally encounters spores and mycelial cells from vegetable moulds. Leukocytes are indicative of an inflammatory reaction. It has been stated that if they occur in large numbers it is strongly suggestive of phlegmonous or suppurative gastritis, an extremely rare condition. It has been my experience, however, to find large numbers of leukocytes in all cases of gastric ulcer, in many of the simple forms of gastritis in the inflammatory or congestive stage, and in cancer of the stomach, affecting chiefly the glandularis. Pathologically, a significant finding is the presence of Oppler-Boas bacilli, which most usually occurs in the subacid or anacid gastric juices, associated with retention and stagnation. Most commonly the presence of lactic acid is readily demonstrable when these bacilli are found. Their presence has so often been seen to be associated with cancer of the stomach as to be extremely suggestive of this condition, but by no means pathognomonic. They are large non-motile bacilli with a somewhat typical morphological arrangement in long chains, and are readily differentiated from the *Leptothrix buccalis* by acting *negatively* to Gram's stain. In gastric sediments prepared as above described they have a tendency to arrange themselves in dense masses, interlaced with one another, and resemble hair-like balls when viewed under a low-power microscope.

The normal stomach should contain very few bacteria, and when they do occur in large numbers it has been considered to be due to a gastric-juice poor in antiseptic property. I believe when the bacterial flora of the stomach is found high that one is dealing with a distinctly pathological condition. The most common normal invader of the stomach is the *Bacillus coli* group, but the appearance of diphtheroid bacilli, staphylococci, and particularly various types of streptococci indicates trouble. Here, too, one meets with a pathologically increased number of leukocytes.

It is surprising how often small isolated fragments or flakes of gastric mucosa will be recovered by this method. Minute particles, barely of macroscopic size, which would readily escape detection in the lavage water, may prove to be the one point upon which the correct diagnosis can be made. Furthermore, it is often possible, from a microscopical study of these bits of mucosa, to determine from which segment of the stomach they come, whether the fundic, prepyloric, or antrum pyloric, bearing in mind the anatomical distribution of the different types of glands. Microscopically, these minute fragments may show only the peripheral portion of the villus, extending down to various depths through the glandularis, while in the larger fragments the entire width of the mucosa, at times including the muscularis mucosæ, will be found. It is often possible to differentiate accurately the following conditions:

Cancer of the Stomach.—It is not uncommon to find (see Figs. 69 and 70) fragments of gastric mucosa which show gastric tubules with broken basement membranes and atypical invasive proliferation of the epithelial cells through the interglandular stroma, and other glands may show various types of degeneration, parenchymatous, mucoid, vacuolar, or atrophic. In all these retrogressive degenerations the staining reactions are poor as compared with the progressive carcinomatous changes. If the fragment of mucosa extends down to the submucosa, finger-like processes of carcinomatous invasion affecting the fundic portions of glands, or even collections or nests of carcinoma cells involving the lymphoid tissue, often showing beautiful mitotic figures, may be found. There is almost invariably a well-marked leukocytic infiltration of the interglandular stroma, frequently associated with pyogenic bacteria, particularly streptococci. When bits of mucosa with recognizable glandular elements cannot be found, one may frequently see microscopical fields showing areas of necrosis, plentifully studded with polynuclear leukocytes and invaded by bacteria. Often in the center of these eosin-stained areas of necrosis may be seen masses of granular amorphous-like débris, staining heavily with methylene-blue or hematoxylin, which suggests the remains of degenerated epithelial cells, carcinomatous or other, in all stages short of coagulation

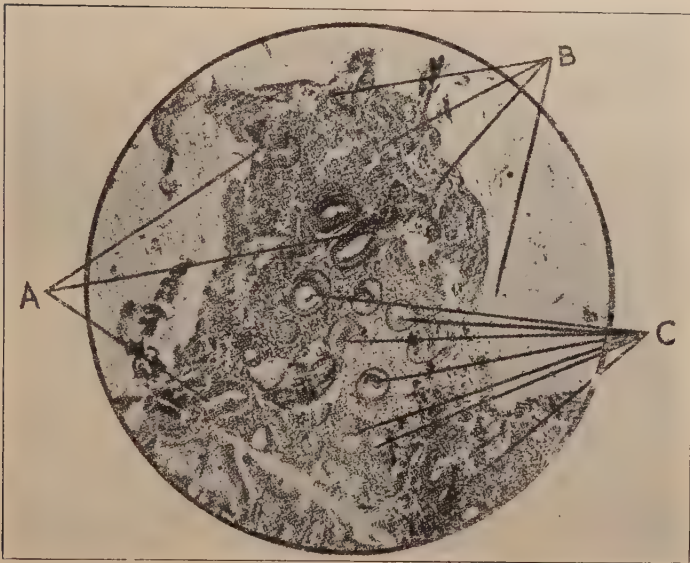


FIG. 69.—Fragment of gastric mucosa showing carcinomatous degeneration. S. H., aged fifty-nine years. Free HCl, 0; total acidity, 52. Lactic acid positive. Occult blood positive. Oppler-Boas bacilli present. *A*, rupture of basement membrane and atypical proliferation of epithelium; *B*, carcinomatous degeneration; *C*, gastric tubules in various stages of atrophy. $\times 100$.



FIG. 70.—Postoperative section (subtotal gastrectomy) from gastric mucosa of S. H., confirming diagnosis of cancer. *A*, nest of cancer cells in muscularis mucosæ; *B*, infiltration of leukocytes. $\times 100$.

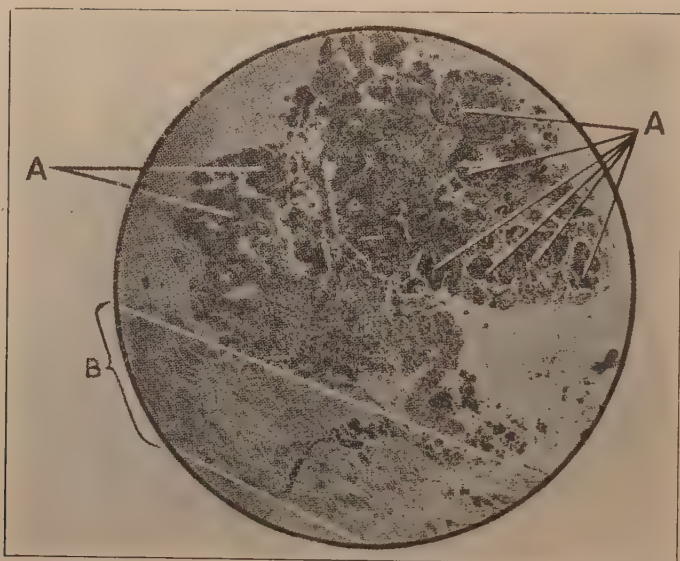


FIG. 71.—Fragment of gastric mucosa from H. M., aged forty-five years, showing a carcinomatous degeneration. A, carcinomatous degeneration of gastric tubules; B, submucosa. $\times 100$.



FIG. 72.—Gastric sediment from J. G., aged sixty-four years, showing necrotic debris and masses of Oppler-Boas bacilli and large numbers of leukocytes. A, necrotic debris; B, masses of Oppler-Boas bacilli; C, necrotic carcinomatous debris; D, collections of leukocytes. $\times 100$.

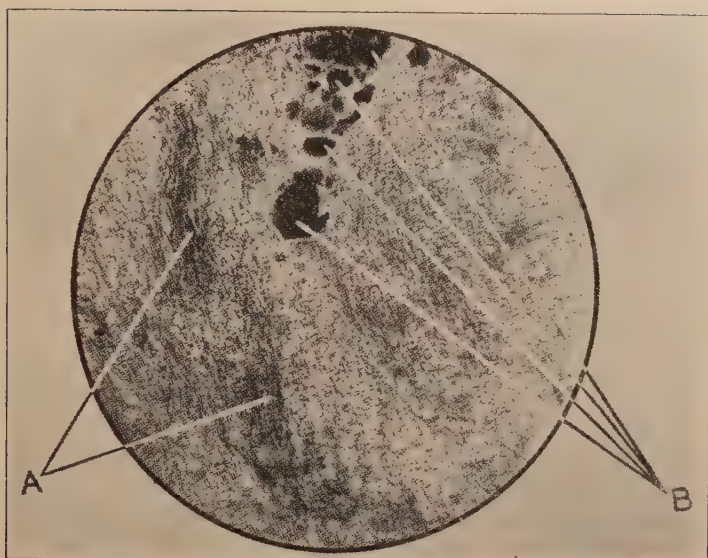


FIG. 73.—Oil immersion of Fig. 72, showing masses of Oppler-Boas bacilli. *A*, masses of Oppler-Boas bacilli; *B*, necrotic carcinomatous debris. $\times 800$.

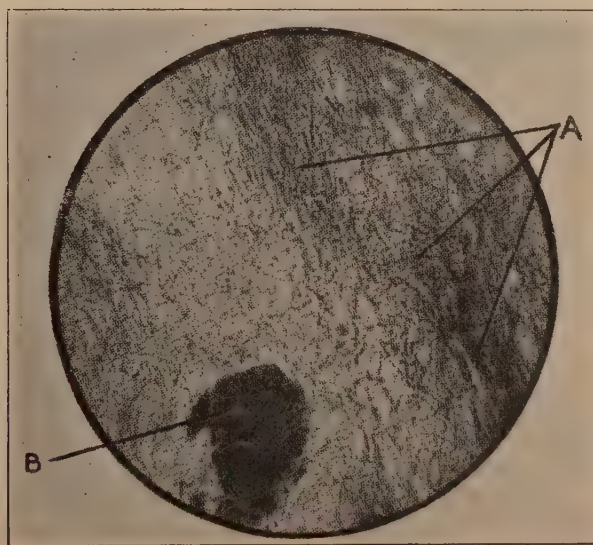


FIG. 74.—Gastric sediment. S. H., aged fifty-nine years, showing large numbers of Oppler-Boas bacilli. *A*, Oppler-Boas bacilli; *B*, necrotic cancer cells. $\times 800$.

necrosis (see Fig. 72). One finds the bacteria massed chiefly at this point, the degenerated cells evidently furnishing an excellent pabulum. Around these necrotic areas will frequently be found immense numbers of Oppler-Boas bacilli, often arranged in such dense clusters of interlaced bacteria as to resemble balls of hair when viewed under high power (see Figs. 73 and 74).

Occasionally one will find fairly large clusters or nests of recognizable cancer cells, often in number up to 100 cells. (See Fig. 75.) In cancer cases with pyloric obstruction the twelve-hour fasting stomach sediment will show various food rests, meat fibers, vege-



FIG. 75.—Nest of cancer cells from H. F., aged sixty-two years. Free HCl, 0; total acidity, 8. Occult blood positive. Lactic acid negative. Oppler-Boas bacilli not found. Wolff-Junghans reaction positive in $\frac{1}{320}$ dilution. A, nest of cancer cells; B, bundles of striated muscle fibers from retained food residue; C, necrotic debris with streptococci invasion. $\times 100$.

table cells, starch granules, fat droplets, or crystals, and if there is fermentation, yeast cells in abundance. Red-blood corpuscles may occasionally be found intact, more commonly in various stages of crenation, and most frequently as hematin crystals. Crystals of bile salts may also be found.

Even if definitely diagnostic isolated cancer cannot be found, the presence of areas of necrosis showing leukocytic infiltration and bacterial invasion will strongly suggest either gastric cancer or gastric ulcer. If Oppler-Boas bacilli are present and the chemical analysis of the gastric juice approaches the subacid or anacid curves

the diagnosis points more particularly to cancer (see Fig. 76). A positive Wolff-Junghans reaction would support this point of view.

It is, of course, understood that, as a rule, these laboratory findings are the tail to the kite as compared to a carefully taken anamnesis, physical examination, and a critical clinical scrutiny of the case; but coupled with the latter they may prove to be the turning-point in the diagnosis, and, indeed, it not unfrequently occurs that the diagnosis is definitely pathologically made by the finding of recognizable cancer cells (see Figs. 69, 71 and 75).

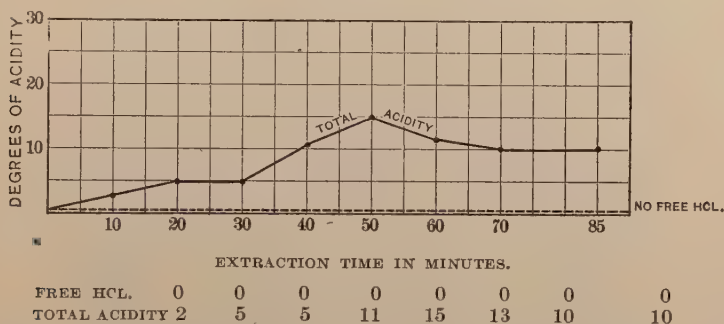


Fig. 76.—H. M., Case IV. December 22, 1914. Cancer of stomach. Total chemical achylia; malignant. Wolff-Junghans reaction positive. Occult blood, ++.

Gastric Ulcer.—While it is more difficult here to make a definitely pathological diagnosis from a gastric sediment study, nevertheless the finding of areas of necrosis with numerous leukocytes and pyogenic bacteria indicates the presence of an ulcerative process whether superficial or deep. The absence of Oppler-Boas bacilli is likewise suggestive. If coupled with this there are bits of the glandularis mucosæ showing the gastric tubules well marked and the cells reacting sharply to the differential stains and the interglandular stroma invaded by leukocytes, the likelihood of this diagnosis would be increased (see Fig. 77). Here, too, one frequently encounters isolated exfoliated epithelial cells, particularly the border or cover cells, reacting well to eosin, either intact or showing granular degeneration. A normal or hyperchlorhydric fractionation curve of the gastric juice, especially when associated with the presence of occult blood, would support this contention. It should be thoroughly borne in mind, however, that the presence of occult blood *by no means* always indicates ulcer or cancer, it being so frequently encountered in superficial erosions, in states of chronic passive congestion with a friable gastric mucosæ, and in many cases of achylia gastrica, as pointed out by J. T. Pilcher (5) in a series of cases studied at the Mayo Clinic.

Chronic Gastritis.—In hypertrophic glandular gastritis and gastritis acida the pathological diagnosis depends upon the finding of fragments or flakes of mucous membrane presenting a well-marked hyperplasia of the glandular elements, with the cells showing good staining power. This applies most particularly to the base or fundic portion of the glands, whereas the cells toward the periphery will often show granular degeneration, loss of staining power, and absence of nuclei. This peripheral portion frequently desquamates

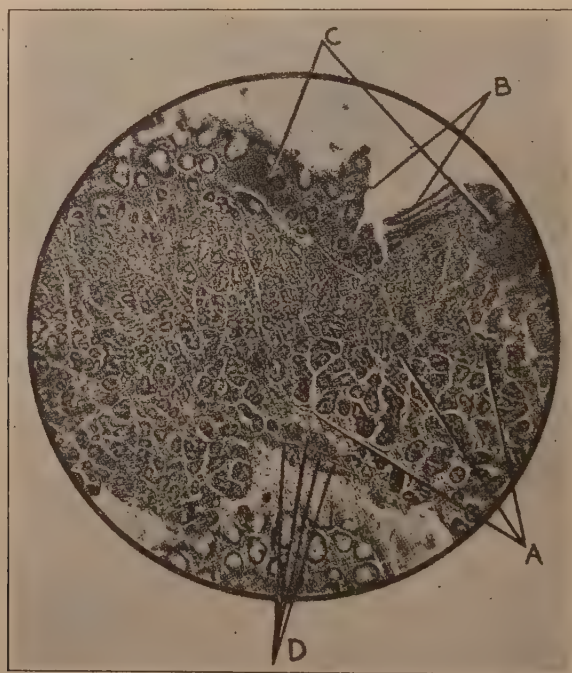


FIG. 77.—Fragment of mucosa from a case of gastric ulcer with free HCl, 86; combined HCl, 21; total acidity, 110. Occult blood positive. A, glandular hyperplasia; B, area of superficial erosions; C, area of congestion (occult blood positive); D, areas of leukocytic infiltration. $\times 100$.

or sloughs off and is found in isolated areas of the microscopic field (see Fig. 78). The interglandular stroma is seen to be infiltrated with an increased number of leukocytes of the lymphoid type in the more chronic processes and a predominance of polynuclear varieties in the acute stages. The venules are usually enlarged or dilated, and areas of pigmentation and congestion may be seen.

Atrophic Gastritis.—Here recoverable bits of gastric mucosa will show a considerable diminution in number of the gastric tubules,

with marked irregularity in their distribution; their alignment is very imperfect and few glands can be traced from fundus to neck. The cells stain poorly and show mucoid and fatty degeneration, with marked vacuolization. Frequently, cells are seen separating or completely broken off from the basement membrane and lying in the lumen of the tubule. In fact, all of the epithelium may be completely denuded from the tubule, leaving empty spaces in the mucosa. (See Fig. 79.)



FIG. 78.—Gastric sediment of fragment of gastric mucosa from case of gastritis *acida* and hypersecretion. S. A., aged fifty-nine years, showing A, inflammatory debris containing many polynuclear leukocytes sloughing off between B, two folds of mucous membrane. $\times 100$.

The leukocytic infiltration is usually of the lymphocytic type, and areas of venous congestion are relatively infrequent. In the same microscopical field, or in other portions of the sediment in the same case, may be found bits of mucosa showing practically normal glandular elements, and it may be rightfully argued that the findings of such microscopical fragments of the mucosa showing various pathological states may not represent a true picture of the amount of organic damage or degree of functional power of the stomach as a whole. Nevertheless, the above findings, associated with the

study of the fractionation curves, will often corroborate or point out the clinical diagnosis.

Achylia Gastrica.—In the recovery of bits of mucous membrane in cases of this type the noteworthy features have been the pronounced reduction in the number of glandular tubules in various stages of benign degeneration (Fig. 79). These degenerations consist chiefly of the mucoid type, which is probably a later stage of a simple parenchymatous degeneration. Later cystic dilatations appear, and in some cases there occurs rupture of basement mem-

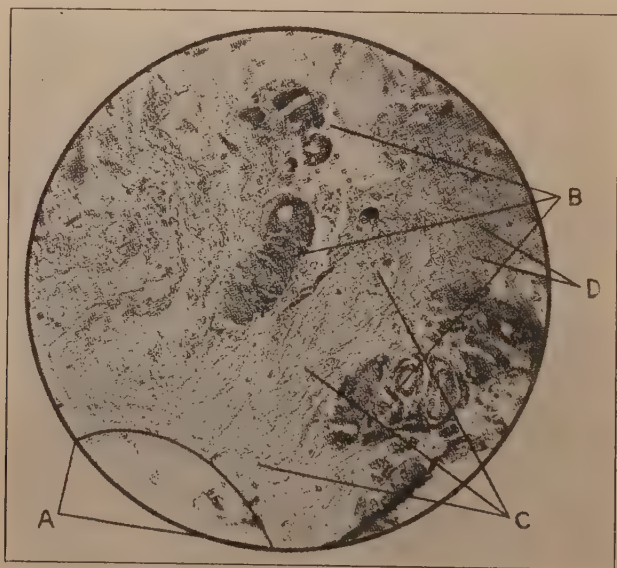
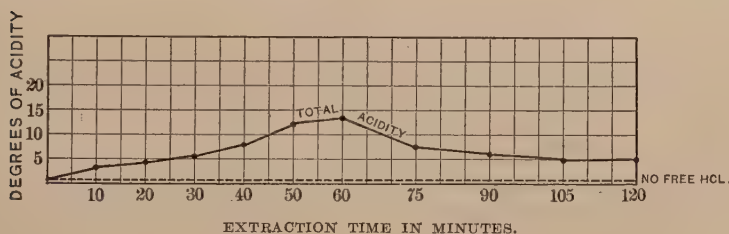


FIG. 79.—Gastric sediment showing fragment of mucosa of the human stomach in a case of advanced, atrophic gastritis. (Achylia gastrica, Mrs. A. H.) A, muscularis mucosae at point of rupture; B, gastric tubules in various stages of atrophic degeneration; C, increase in interglandular connective tissue; D, area of congestion. $\times 100$.

branes with atypical epithelial proliferation, showing a tendency to invade the surrounding stroma. Such cases should be most carefully investigated, and repeated attempts to recover additional mucosal fragments should be made, as it may prove to be a transitional stage between a benign and an early malignant achylia. Particular in these cases does the Wolff-Junghans reaction offer a possible means of differentiation. In all this group of cases there is a marked increase in connective tissue in the interglandular stroma, and at times wide bands of it may be seen separating small islands of degenerated tubules. Indeed, it is possible that

this connective tissue overgrowth in the benign achylia may be a forerunner of that rare condition linitis plastica. The depth of the glandularis is strikingly diminished, and it is not uncommon to find that a single low-power microscopic field takes in the entire depth and width of the glandularis, including the muscularis mucosæ. at which point rupture most commonly occurs. At the peripheral portion of the glandularis may be seen dilated venules markedly congested and with extravasation or diapedesis of red-blood corpuscles, which explains the occasional (frequent?) demonstration of occult blood. (5) At the peripheral portion, too, may be found a deep layer of mucus, and islands of mucus may also be seen in isolated portions of the sections.

When one is successful in recovering fragments of mucosa showing these pathological changes it checks up nicely the fractionation curves of the achylic type and would serve to differentiate between the psychical achylia occurring during the first stage of digestion and the total chemical achylia persisting throughout the entire digestive cycle (see Fig. 80).



EXTRACTION TIME IN MINUTES.										
FREE HCL	0	0	0	0	0	0	0	0	0	0
COMB. HCL.	0	0	0	0	0	0	0	0	0	0
TOTAL ACIDITY	1.5	4	5	8	12	13.5	7	6	5	5
ENZYMES	0	0	0	0	0	0	0	0	0	0
PROENZYMES	0	0	0	0	0	9	0	0	0	0
OCCULT BLOOD	0	0	0	0	0	0	0	0	0	0

FIG. 80.—Mrs. A. H. January 12, 1915. Achylia gastrica. Wolff-Junghans, negative. Total chemical achylia; benign.

Gastric Atony with Dilatation.—In the early cases the sediment returns are usually negative save for amorphous debris and patches of mucus in which are enmeshed occasional leukocytes. In the more advanced cases with benign motor insufficiency are found various food rests even on a twelve-hour fasting stomach, although it is uncommon to find this unassociated with some degree of pyloric stenosis.

Gastric Dilatation with Fermentation.—In cases of gastric dilatation with fermentation one will frequently find in addition groups of sarcinae, germinating yeast cells, spore-bearing fungi, and mycelial threads. Bacteriologically, many groups of organisms may be represented, chiefly, however, of the spore-bearing type.

Hypersecretio Continua (Reichmann's Disease).—Oftentimes the sediments are practically negative except for a granular amorphous débris with crystalline deposits of bile salts. If there is an associated inflammatory condition (a gastritis), one will find the nuclei of numerous leukocytes with protoplasm digested as well as free nuclei from exfoliated epithelial cells. In the inflammatory types under oil immersion can frequently be made out a marked increase in the bacterial flora. Since so many cases of hypersecretion are found associated with gastric dilatation sequential to either atony, pylorospasm, pyloric stenosis, or chronic appendicitis, food rests may be frequently encountered.

Esophageal Sediments.—Similarly, in douching the esophagus by this method one may recover esophageal sediments of diagnostic import, as in cases of cardiospasm with esophageal dilatation. In cases of esophageal cancer, minute bits of tissue containing nests of cancer cells may be found, together with necrotic débris, studded with leukocytes and invaded by bacteria. In cases of esophagitis following the ingestion of corrosive poisons there may be recovered bits of necrotic mucosa showing a high degree of ulcerative inflammation. It is noteworthy that in cardiospasm, and I believe this to be pathognomonic of this condition, it will be found possible to douche the esophagus and recover from the esophagus all of the lavage fluid introduced without having to pass the tube into the stomach.

Returning, now, to a more general discussion of the subject, we should consider that gastric analysis is primarily a measure of gastric work, fasting and digesting, motor and secretory, as has been pointed out by Rehfuess and Hawk (9) and in order to measure the work done and compare it with a normal, a standard test load must be given the stomach to handle. This measure of work is in reality the measure of the physiological function of the stomach, secretory and motor, and any deviation from the normal in either acid values or motor activity must be viewed only in the light of pathological physiology. But gastric analysis when intelligently conducted is more than just a measure of the work done, it is an indicator of true intragastric pathology. The evidence of such pathology, however, lies in the addition to the gastric juice of the products of that pathology. These are mucus, exfoliated epithelial elements, pus, blood, and bacterial colonies.

And there is a third and equally important side to gastric analysis, namely, that it serves as an indicator of extragastric pathology. It has long been recognized that most systemic conditions, and many strictly local conditions, even though far removed from the stomach, may influence that viscus. The evidence of such influence is seen

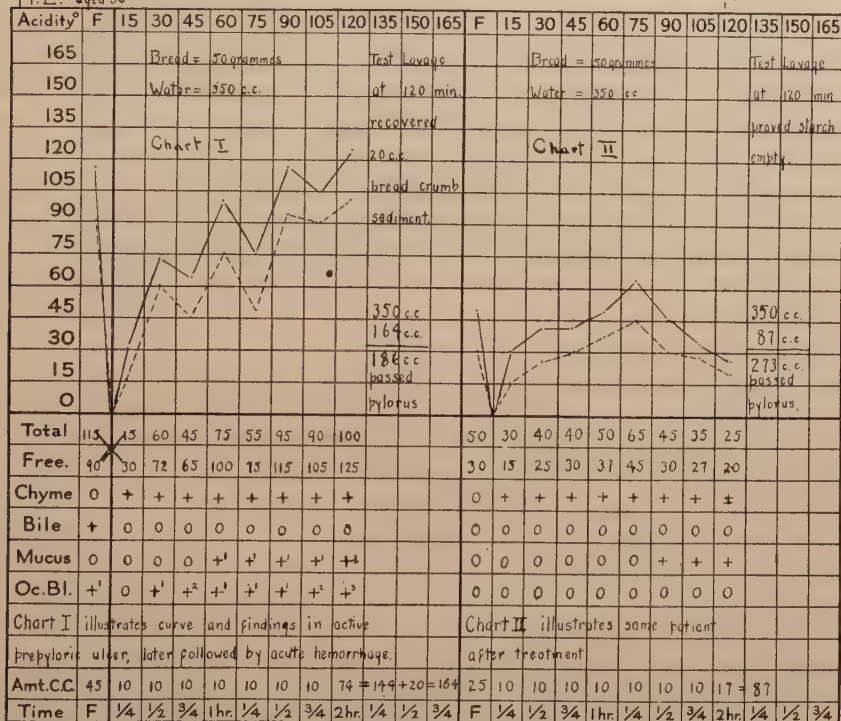
indirectly in its effect on the acid curves, and directly by the finding of products of this extragastric pathology added to the gastric secretions. Examples of this latter are the finding of swallowed pus from various sources and the occurrence of occult blood asso-

H.Z. aged 30

Date, Dec. 8, 1919.

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Date, April 1920.



Esoph. Obstruct.	0	0	CHEMISTRY:		MICROSCOPY:		BACTERIA:		IMPRESSION:	
Took tube well?	Y	Y	Lactic Acid,		Food Rests,	0	Flora, normal	+	Motility,	slow
Retching,	0	0	Pepsin,		Mucous Strands,	+	" increased	+	Obstruction,	0
Nervous,	0	0	Pepsinogen,		Mucous Snails,	0	Free,	+	Cardiospasm,	0
Tonus,	N	N	Rennin,		Epithelium,	0	Masses,	+	Pylorospasm,	0
FASTING RESIDUUM:			Renninzymogen,		Respiratory,	+	Colonies,	+	Secretion,	+
Ewald, H ₂ O, Boas, Riegel,	E	E	Trypsin,		Oral,	+	Bile Stained,	+	Acidity,	N
Motor Meal 12 hrs. before	✓	✓	Bile,		Esophages,	0	Bacilli, long,	+	Gastritis,	+
Amount	c.c.	45	Oc. Bl.-B	+	Gastric,	+	" short,	+	" Infective,	0
Sediment	c.c.	25	Oc. Bl.-G	+	Duodenal,	+	Oppler-Boas,	+	Bleeding,	0
Color,	vel. grey	3	Wolf-Jungheans,	+	Biliary,	0	Cocci, chains,	+	Trauma,	+
Odor,	+	0	Special,		R. B. C.	0	" clumps,	+	Congestion,	+
Bile,	+	0			W. B. C.	+	" diplo.	+	Ulceration,	+
Mucus, Floating,	0	0	SALIVA:	c.c. 70	W. B. C. Digested,	+	Yeast,	0	Carcinoma,	0
Mixed,	0	0	secreted in 2 hours,	40	W. B. C. Bile Stained	+	Sarcinae,	0	Achylia, Chem.	0
Blood,	0	0			Bile Salts,	+	Culture,		" Psychic.	0
Retention,	0	0			Crystals,	0			Biliary Regurg.,	0
									Fasting,	0
									Digesting,	0

FIG. 81.—Curve and findings in active prepyloric ulcer, later followed by acute hemorrhage.

FIG. 82.—Curve and findings in same patient after treatment.

ciated with biliary regurgitation which, according to Rehfuss (6), is the only direct evidence of duodenal ulcer to be obtained from a gastric analysis (Figs. 84 and 91). To this should be added the findings of regurgitated duodenal epithelium, pus, mucus, and bacteria.

Whenever there is any deviation from the normal values in a given gastric analysis it is of the utmost importance from the clinicians' viewpoint to determine whether these variations are due to intragastric pathology, or are the indirect evidence of conditions outside the stomach. But before the deviations from normal can be appreciated it is necessary that we have some conception of what constitutes normal findings in a test conducted as outlined above. I will, therefore, briefly discuss what I consider to be *normal findings* as found in patients who not only have no gastrointestinal ailments, but are also free from any general or other local conditions. I will then point out the chief types of *pathological curves*.

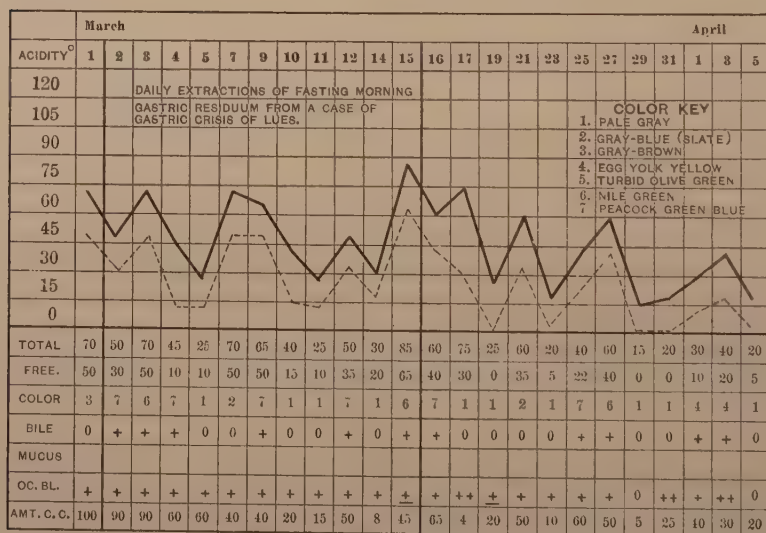


FIG. 83.—Shows variations in fasting acid values.

THE TWELVE HOUR FASTING STOMACH CONTENTS.

The *amount* varies in health from a few cubic centimeters to 50 to 80 cc; anything above that amount being due either to hypersecretion or retention, that question being decided by the microscopical picture. *Sediment* up to 5 per cent of the total amount recovered I consider to be within normal limits. *Mucus* that

PLATE II

FIG. 1

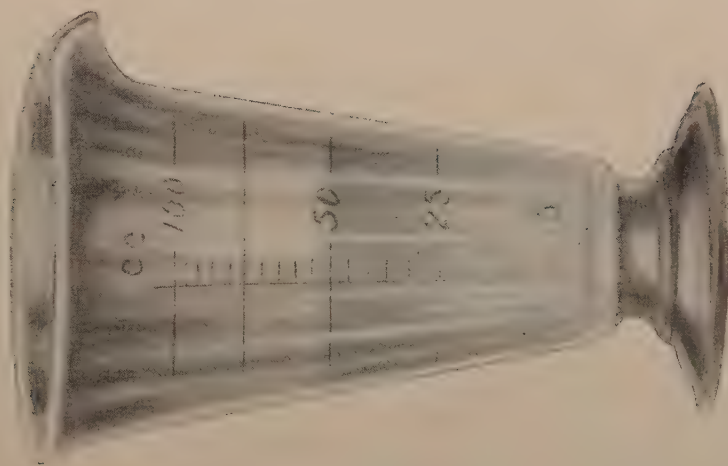


FIG. 2

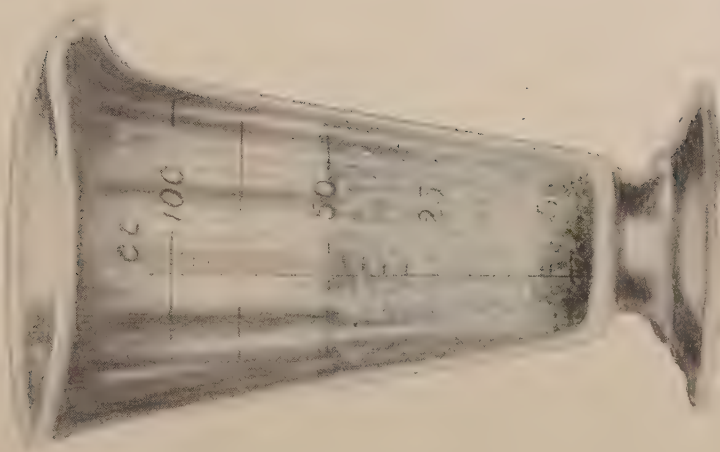


Fig. 1. Normal fasting residuum from clean stomach. Fig. 2. Fasting residuum from "dirty" stomach normal as to amount, but *pathological* as regards increased sediment (12 per cent) and increased mucus.

floats is generally freshly swallowed, whereas the type of very viscid, stringy, intimately mixed mucus is usually associated with absence of free hydrochloric acid at that particular period of the gastric cycle. I have found the *acid values* of the fasting stomach to vary within wide limits. Attention has been called by different writers to the fast and slow motility of normal stomachs, and I feel that there should be a comparable secretory classification of high and low stomachs both within normal limits. It would seem that this question of "fast and slow," "high and low," is often dependent on the *habitus* of the individual, and that this fact must be kept in mind. This accounts for the variations in the acid values in different persons, but I have also found that if the stomach contents of the same individual are examined daily under the same conditions of time, and length of preceding fast, great variations of acid values will also frequently be seen. (See Fig. 83.) The explanation of this is, I believe, that the level of acidity in the interdigestive stomach is an expression of a vital function, and like other vital functions it fluctuates from day to day and is easily influenced by such things as loss of sleep, worry, nervousness, or overeating, drinking or smoking the night before the examination.

CLINICAL SIGNIFICANCE OF FASTING AND DIGESTING BILIARY REGURGITATION.

The question of *biliary regurgitation* is one to which I have given considerable attention. I believe that *frank macroscopical regurgitation* of bile into either the fasting or digesting stomach is, with certain exceptions, an *abnormal* finding and points to disturbed physiology of the pylorus and duodeno-biliary apparatus or to pathology within the latter zone. The *exceptions* to this statement are: First, if the patient does not take the tube well, but gags and coughs, bile may be squeezed out of the gall-tract by the simultaneous contraction of the abdominal muscles and the diaphragm, and be regurgitated into the stomach. Second, in those cases of marked hyperacidity, alkaline duodenal contents mixed with bile may be regurgitated into the stomach in a physiological effort to lower the excessive acid (Fig. 85). I have been led to this opinion by the following facts: In healthy individuals the duodenum in the fasting state is bile-free. The normal direction of progression of the contents of this portion of the gastro-intestinal tract is aboral—there should be no reserved peristalsis. Interference with the innervation of this portion of the gut by operative procedure, excision of duodenal ulcer, cholecystostomy and cholecystectomy increased the percentage of biliary regurgitation. Post-operative cases showed a larger percentage of biliary regurgitation

than non-operative cases, and those showing evidence of pathology in the upper right quadrant showed a higher percentage than those in whom no pathology could be demonstrated.

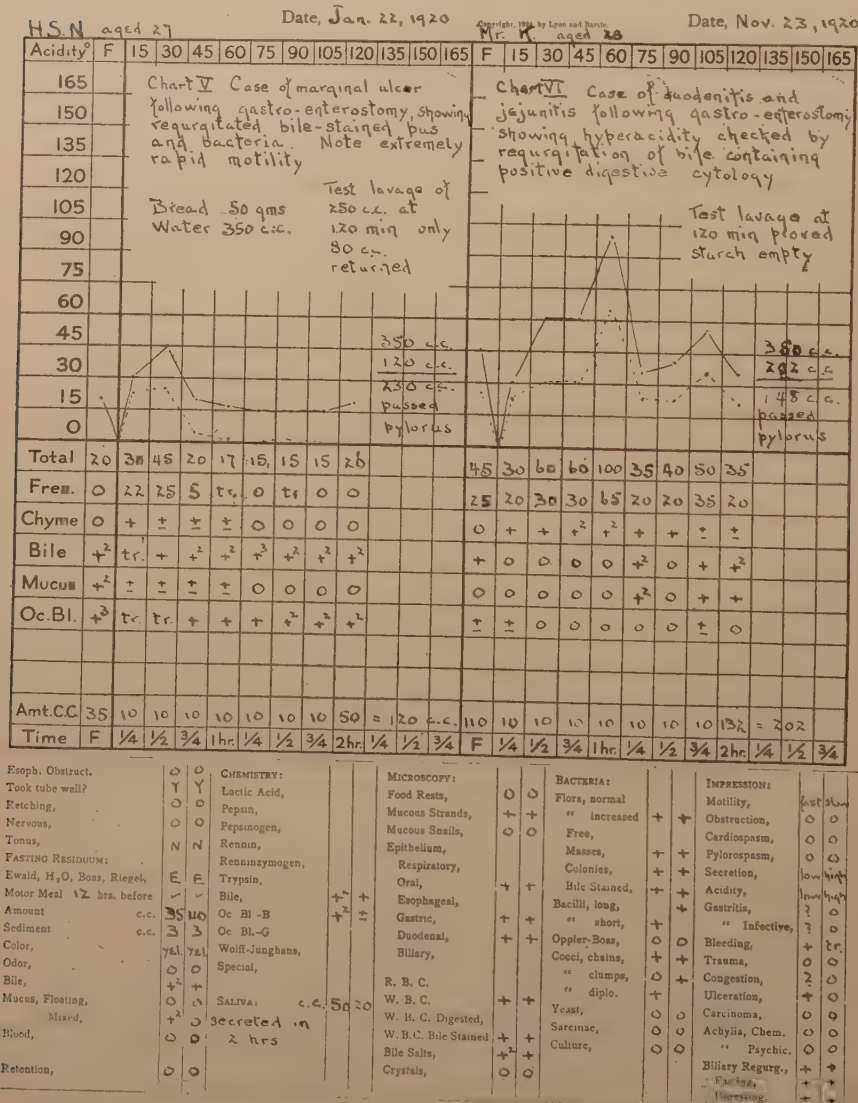


FIG. 84.—Case of marginal ulcer following gastroenterostomy showing regurgitated bile stained pus and bacteria. Note extremely rapid motility.

FIG. 85.—Case of duodenitis and jejunitis following gastroenterostomy showing hyperacidity checked by regurgitation of bile containing positive digestive cytology. Test lavage at one hundred and twenty minutes proved starch empty.

PLATE III



Plate III represents fasting stomach residuums with frank biliary regurgitation, to be interpreted as pathological, with exceptions noted on page 237. If gastric acidity is high the bile will have an egg-yolk-like turbidity (see page 115).

Most of the writers on this subject have stated that bile in the stomach is a *normal finding*, being present in about 50 per cent of cases. One of the great difficulties in gastro-intestinal work is to determine accurately so-called normals. Simple absence of presenting complaints does not mean that there is no disturbance of physiology or actual pathology present. To realize this one only has to think of the spontaneous remission of symptoms so common in duodenal ulcer, although the ulcer is far from healed. Medical students, to my mind, furnish the least satisfactory group for the determination of so-called normals.

In a study of a series of 100 cases of fractional analysis on patients with gastro-intestinal complaints I found fasting regurgitation in 36 per cent and digesting regurgitation in 23 per cent. In spite of these lower figures I wish to emphasize that I consider biliary regurgitation an abnormal condition, especially when encountered in the digesting stomach. Jarno (2) found that there was a regurgitation of bile into the fasting stomach in association with the normal hunger contractions, and this may account for the finding of *traces* of bile in fasting stomachs.

Furthermore, in a second series of 132 consecutive cases which I examined in Naval Base Hospital No. 5 at Brest, France, during 1917 and 1918, the significance of gross biliary regurgitation becomes apparent. All of the patients examined were robust males fit for military service, but were referred to the Stomach Department as having gastro-intestinal complaints.

Analyzing These 132 Cases I Found that:

29 cases showed fasting morning stomach biliary regurgitation alone.

7 cases showed digesting stomach biliary regurgitation alone.

12 cases showed fasting and digesting biliary regurgitation.

A total of 48 cases, or 36 per cent of the series of 132 cases.

Analyzing These 48 Cases:

In 33 per cent of them the biliary regurgitation did not appear to have any clinical significance.

But in 67 per cent of them the biliary regurgitation appeared to have important clinical significance.

For on analyzing this latter group I found that biliary regurgitation occurred in:

6 out of 9 cases (or 67 per cent) of duodenal ulcer.

12 out of 21 cases (or 57 per cent) of appendicitis.

9 out of 15 cases (or 60 per cent) of gall-tract disease, chiefly cholecystitis.

1 out of 1 case (or 100 per cent) of postoperative adhesions in upper right quadrant.

7 out of 21 cases (or 33 per cent) of secretory error (hyperacidity) of stomach.

Perhaps this last group could be omitted as representing a compensatory mechanism to neutralize the high acidity.

MICROSCOPICAL EXAMINATION.

The microscopical examination of the fasting stomach contents is of the greatest importance, in fact I attach more importance to it than to the motorsecretory curve in determining gastric pathology. The whole question of the interpretation of the microscopical picture seen is one of *relative* values, for prolonged search may reveal examples of all the types of cellular elements. As was said above, sediment amounting to 5 per cent of the amount extracted may be considered within normal limits, but anything above this must be looked upon as pathological, and its source must be fixed. Swallowed mucus either floats or is seen in dense masses, while duodenal mucus is usually associated with biliary regurgitation. Gastric mucus when seen grossly is generally flocculent. All these types may be seen in the same sediment, and if so each must be examined and the relative amounts noted.

In making a preparation for microscopical examination a small amount of the material is placed on a slide and a cover slip dropped on top. I prefer routinely to use unstained preparations except in searching for particular elements when various differential stains may be used. On looking at them with the high power objective it will be seen that either the cells are practically intact or that the cytoplasm is entirely digested away (Fig. 86), leaving only the more resistant nuclei. The nuclear remains of gastric cells are oval, highly refractive bodies, and the polymorphonuclear cells are seen as groups of two or three small globules. There is always a certain number of leukocytic cells in the fasting stomach, but if these occur in sufficient numbers to constitute pus, they are a distinctly pathological finding. The type of epithelium with which the pus is associated is the deciding factor in locating the point of its discharge, and the finding of a predominance of buccal or respiratory epithelium should lead to a careful search of the mouth and respiratory tract for evidence of infection (Fig. 87). In an acid stomach both the chief and parietal types of gastric cells as well as the goblet mucus cell may often be seen, but it must be remembered that these, as well as other cells, are dead or dying, and usually show cloudy swelling (Fig. 17, page 31.)

In regurgitation from the duodenum the cytology is usually



FIG. 86.—Hyperacid catarrhal gastritis; A, buccal epithelium digested; B, nuclear remains of digested gastric cells; C, nuclear remains of digested leukocytes; D, mucus spirals (myelin?) in "snail" forms; E, bacteria in clumps and masses.

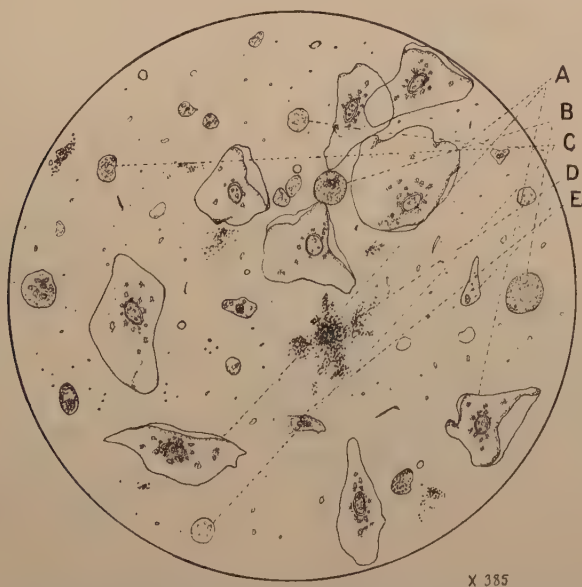


FIG. 87.—Gastric subacidity,—with extragastric cytology; A, buccal epithelial cells; B, salivary corpuscles; C, leukocytes or pus cells with protoplasm intact; D, colony of cocci; E, occasional gastric epithelial cells.

very well preserved if an examination is made promptly. Duodenal cells (round, cuboidal, or oval cells somewhat longer than pus cells) can be recognized, and at times bile stained columnar epithelium from the biliary tract can be seen. The *very tall* bile stained columnar epithelium I believe is only derivable from the gall-bladder. (See Figs. 18 and 20.) *Bile stained pus cells*, when found in association with this latter type of epithelium, point to inflammation somewhere in the duodeno-biliary tract. When bile is regurgitated into a stomach containing free hydrochloric acid, the bile salts are precipitated, giving the material a grossly turbid appearance, and microscopically appear as small clumps and masses of yellow amorphous material. When such regurgitation takes place in an anacid stomach there is no such precipitation. Bile that has remained in the acid stomach for some time assumes various shades of blue and green, due to oxidation or other chemical changes and can readily be differentiated from freshly regurgitated bile from gagging or other reflex causation. (See Fig. 83.) The color changes so produced have by some authors been thought due to the action of chlorophylic bacteria. Perhaps this is true, although I have never been able to convince myself of this from personal studies.

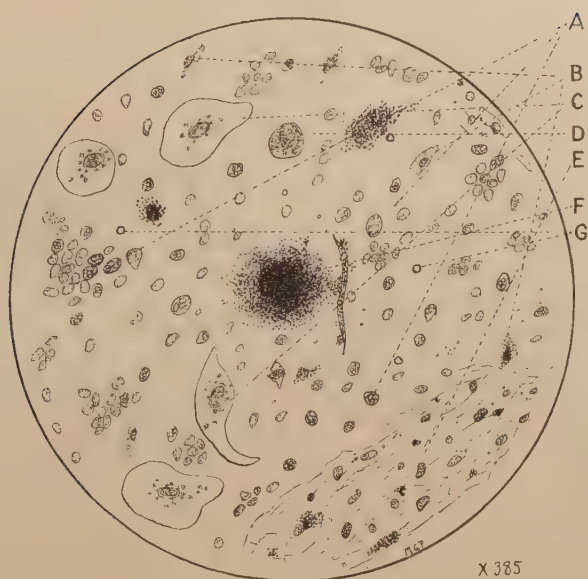
Normally there is no gross or microscopical evidence of *food retention* in the twelve hour fasting stomach. Retention when found is not pathognomonic of any one pathological process, but it is frequently enough associated with graver conditions in and about the pylorus to necessitate a careful investigation into the causative factor. (Atony, pylorospasm, adhesions, stenoses from inflammatory edema, hypertrophy or from new growth within or without.)

The question of the *bacterial flora* of the stomach is one upon which much still remains to be written. Bacterial bodies can always be found in the stomach, but whether they are living organisms, and whether they are truly resident in the stomach, constituting an infected gastritis, or only in transit, are points of prime importance to determine. To answer the second question first, bacteria that are in transit are seen as single organisms or grouped in small masses. If, however, viable organisms linger long enough to become implanted in the gastric mucosa they grow in *colony* formation (Fig. 88) just as colonies grow on the surface of any suitable media. When they become detached and are seen in the fasting stomach contents they are entirely similar to the surface colonies of a Petri culture plate when viewed through a low power ocular. The final answer to the question of viability must depend on culture, but I feel that for all practical purposes the finding of colonies associated with gastric mucus or epithelium is positive proof of the presence of infection in the gastric mucosa. Particularly is this so if they occur conspicuously in the floccules pressed

PLATE IV

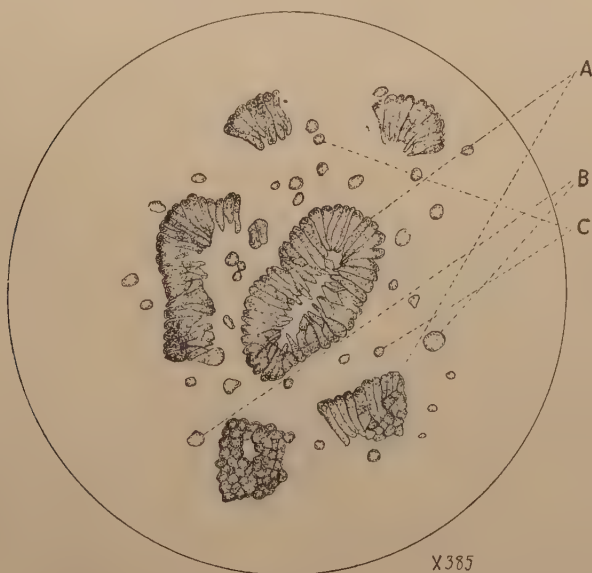


Plate IV represents fasting stomach residuums containing frank bile which has been regurgitated into the stomach a considerable period of time before extraction. See page 262.



X 385

FIG. 88.—Anacid gastritis; A, pus cells, with cloudy swelling of protoplasm, predominating feature; B, gastric epithelium, degenerated; C, buccal epithelium; D, salivary corpuscle; E, strand of mucus, with bacteria and pus cells; F, colony of bacteria; G, red blood corpuscles.



X 385

FIG. 89.—Catarrhal exfoliative cholecystitis; A, tall bile stained columnar epithelium from gall-bladder, arranged in fan shapes and rosette clusters; B, oval or cuboidal duodenal epithelial cells; C, pus cells or leukocytes, appearing much like duodenal cells but usually smaller. Note: The nuclei can be brought out by adding dilute acetic acid.

out from the gastric tubules after washing the stomach clean and then rewashing with an astringent solution. The colonies are microscopically here found associated with exfoliated gastric epithelium, pus cells and inflammatory débris.

To the finding of *occult blood* in the fasting stomach I do not attach much importance unless the benzidine reaction be very strong and the guaiac reaction positive. This is because, in spite of the precaution taken, it is often extragastric in origin. It is only definitely of value when the nasopharyngeal and bronchial secretions have been proved to give negative reactions.

Freshly prepared solutions of benzidine are sensitive to the detection of blood in dilutions as weak as 1/600,000. Therefore, this test is perhaps too delicate to detect true pathological bleeding unless the reaction is very strong. Guaiac is much less sensitive. Therefore, I prefer to use benzidine as an exclusion test to rule out all types of bleeding and guaiac as a provement test for pathological bleeding.

TYPE OF CURVE.

Having completed the examination of the fasting stomach content, the next point in the examination is the analysis of the *type of curve* obtained. I agree with Best (1) who says, "The actual acid value means very little. The shape of the curve means more," and with Rehfuess (6) who says, "There is no pathognomonic curve in any gastric condition," and yet I feel very strongly that there are certain types of curves that "point" to certain conditions. From a study of many analyses I find that they all fell into one of five groups. Any of these groups, with the exception of the third, can be associated with either hyperacidity or subacidity. The question of the *amount of acid* secreted in response to the stimulation of the test meal seems to me to depend on the irritability of the vagus, and the state of fatigue or integrity of the gastric glandulature.

Type I. *Normal curve*. This is the type of curve in which the apex is reached in from sixty to seventy-five minutes, and a return to within 15° of the fasting values occurs at one hundred and twenty minutes. It is the type of curve seen in perfectly healthy persons and also in certain early states of intragastric conditions—principally catarrhal. The points indicative of an early catarrhal process are gastric mucopus in the fasting stomach content, and mucus and perhaps traces of blood in the digesting stomach.

Type II. *Extragastric curve* (Figs. 90 and 91). In this type the curve rises steadily during the entire two hour period, or until the stomach becomes empty if there is an associated hypermotility. This is the type of curve that is usually found due to reflex irritation from *pathology outside* the stomach. It is frequently seen in

PLATE V

FIG. 1



Fig. 1. Pathological fasting residuum of mixed regurgitated bile and blood from duodenum from a case of duodenal ulcer associated with cholecystitis.

FIG. 2

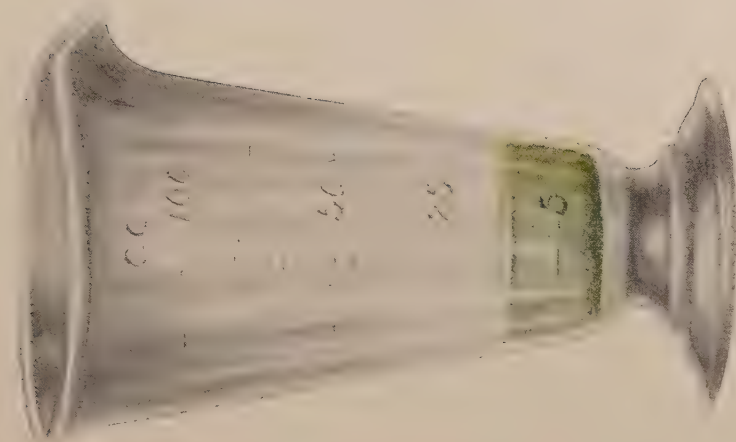


Fig. 2. Fasting residuum, borderline between normal and pathological, representing deficient amount of fasting secretion with small amount of biliary reflux and increased percentage of sediment regurgitated from duodenum.

cases of duodenitis, duodenal ulcer, gall-bladder conditions, appendicitis and sigmoiditis. It may be found in association with a clean

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Mr. F.

Date, -/5/20

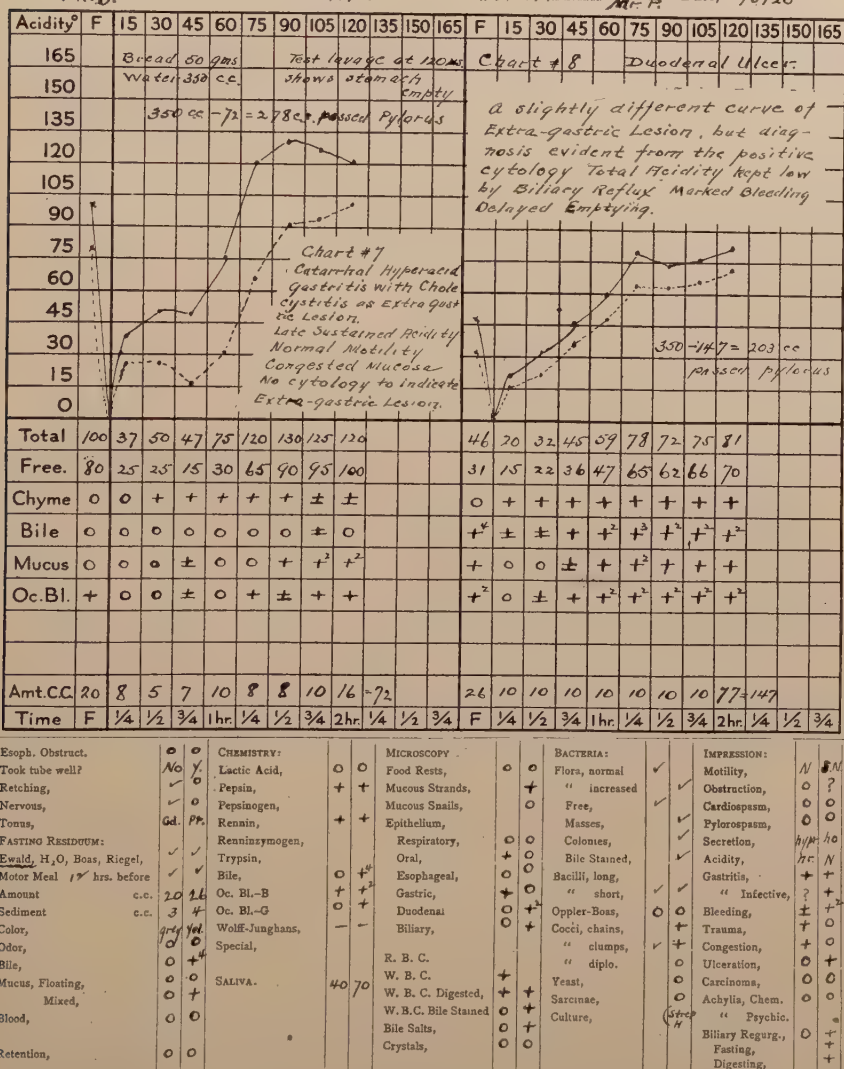


FIG. 90.—Catarrhal hyperacid gastritis with cholecystitis as extragastric lesion. Late sustained acidity, normal motility, congested mucosa. No cytology to indicate extragastric lesion.

FIG. 91.—Duodenal ulcer. A slightly different curve of extragastric lesion, but diagnosis evident from the positive cytology. Total acidity kept low by biliary reflux. Marked bleeding delayed emptying.

stomach or with all the evidence of a high grade infected gastritis, but in either case the principal source of trouble is extragastric. (Exception: functional pylorospasm.)

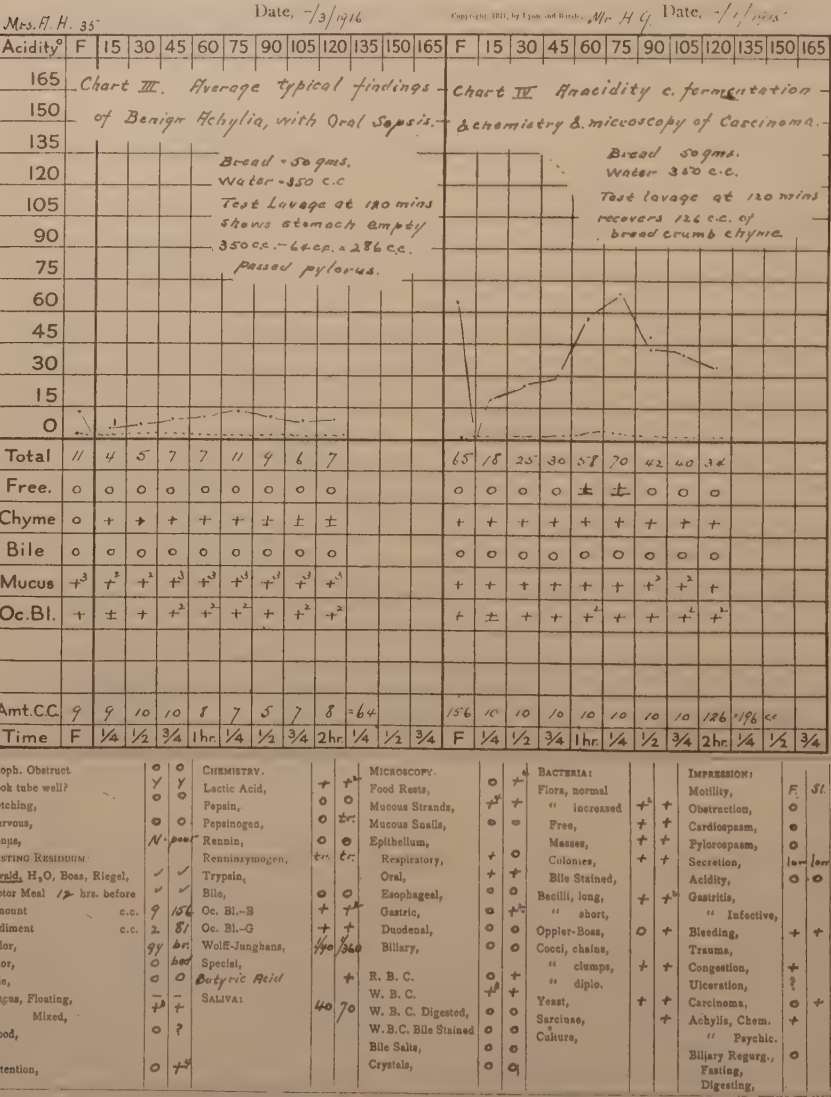


FIG. 92.—Average typical findings of benign achylia with oral sepsis.

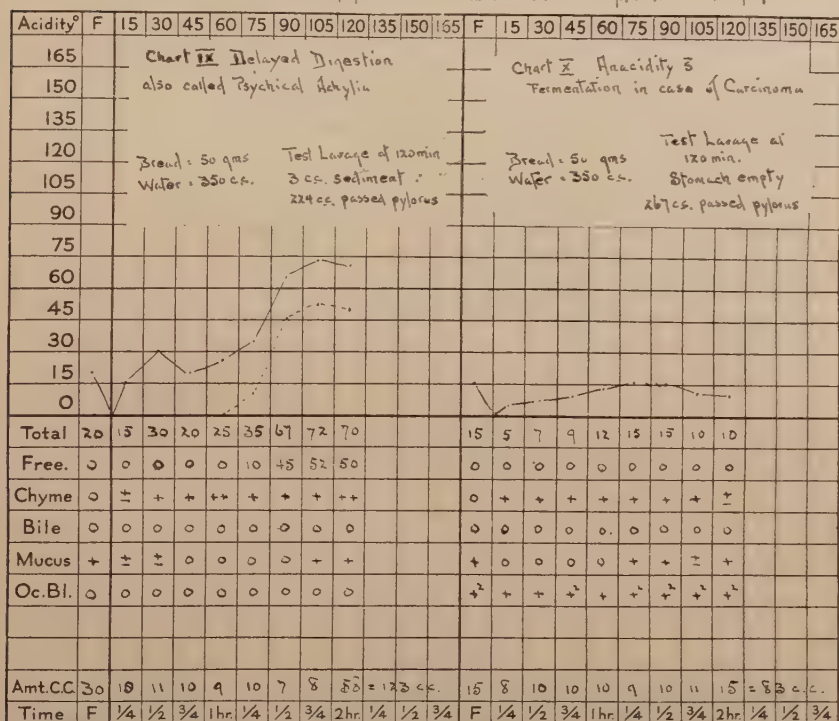
FIG. 93.—Anacidity with fermentation and chemistry and microscopy of carcinoma.

Type III. *Achylia*. This is a type of curve in which there is no free hydrochloric acid present at any time. It is most frequently seen in cases of malignancy of the stomach in the later stages, in oral sepsis, long standing cholelithiasis, and in the severe

Mr. E.

Date, 8/3/20

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Esoph. Obstruct.	0	0	CHEMISTRY:	0	+	MICROSCOPY:	0	0	BACTERIA:	+	IMPRESSION:	Sh.	N
Took tube well?	Y	Y	Lactic Acid,			Food Res.,	0	0	Flora, normal		Motility,		
Retching,	0	0	Pepsin,	+	0	Mucous Strands,	±	+	" increased	+	Obstruction,	0	0
Nervous,	0	0	Pepsinogen,		0	Mucous Smalls,	0	0	Free,	+	Cardiopasm,	0	0
Tonus,	F	F	Rennin,	+	0	Epithelium,			Masses,	+	Pylorospasm,	0	0
FASTING RESIDUUM:			Renninogen,			Respiratory,			Colonies,	+	Secretion,	late	
Ewald, H ₂ O, Boas, Riegel,			Trypsin,			Oral,	+	+	Bile Stained,		Acidity,		
Motor Meal hrs. before	12	12	Bile,	0	0	Esophages,			Bacilli, long,		Gastritis,	0	
Amount c.c.	60	15	Oc. Bl.-B	0	+	Gastric,	+	+	" short,	+	" Infective,	0	0
Sediment c.c.	5	3	Oc. Bl.-G	0	+	Oppler-Boss,			Cocci, chains,		Bleeding,	0	+
Color,	gray	gray	Wolf-Janghans,		1/2	Duodenal,			" clumps,		Trauma,	0	
Odor,	0	0	Special,			Biliary,			" diplo,	+	Congestion,	0	
Bile,	0	0				R. B. C.			Yeast,	+	Ulceration,	0	
Mucus, Floating,	+	+	SALIVA: Secreted		50	W. B. C.	+	+	Sarcinae,	0	Achylia, Chem.	0	+
Mixed,	+	+	in 2 hrs		50	W. B. C. Digested,			Culture,	0	" Psychic.	+	0
Blood,	0	0				W. B. C. Bile Stained					Biliary Regurg.,	0	0
Retention,	0	0				Bile Salts,					Digesting,		
						Crystals,							

FIG. 94.—Delayed digestion, also called psychical achylia.

FIG. 95.—Anacidity without fermentation in case of carcinoma.

anemias, either primary or secondary. Differentiation of the type of achylia comes from the testing of gastric filtrates for organic acids, proenzymes, and for the soluble albumin (Wolff-Junghans reaction) and from the microscopical picture. (Figs. 92 and 93, see also Fig. 95.)

Type IV. *Stepladder curve*. In this type of curve the smooth ascent is broken by drops in both free hydrochloric and total acid, unassociated with biliary regurgitation, followed by a rise to a still higher level than that preceding the drop (see Fig. 81). This curve is not often seen, but is of grave significance. I have only seen it in ulcer cases in the active stages, and it is generally preceded or followed by hemorrhage. Best (1) illustrates a curve of this type, and notes that there was a recent hemorrhage.

Type V. *Delayed digestion curve*. In this curve there is a primary small rise followed by a drop, and then by a practically normal curve. In certain cases of this type the free hydrochloric acid does not come in until the secondary rise, and it corresponds to the psychical achylia of some writers (Fig. 94). A possible explanation of this type of curve is that the primary rise represents the psychic secretion, and the secondary rise the hormonal secretion. The latter, which should normally pick up and carry on the psychic secretion, is delayed, and therefore permits of a wearing off of the psychic stimulus and a consequent drop in the acid values.

FURTHER ANALYSIS OF THE DIGESTING STOMACH.

In addition to the study of the fasting stomach content, and an analysis of the type of curve, there are certain other findings which must be tabulated. The *motor element* is of great importance, and when carried out as detailed earlier in this chapter, I believe will give a more accurate estimate of gastric motility than the roentgen-ray examination for six hour barium retention or from any other unphysiological test meal. In all cases of achylia the associated tests mentioned above should be done. The details of these reactions do not fall within the scope of this book, but can be found in any standard work on the stomach.

Mucus, when found in all the extractions, especially when associated with low salivary output (gauged by measuring the amount of saliva spat out during the two hour test), is probably swallowed; whereas mucus, appearing only in the second half of the examination, is generally gastric in origin. The interpretation of bile in the digesting stomach has been discussed above and need not be repeated here. The finding of blood in the digesting stomach must not be taken as evidence of ulcer or neoplasm unless the evidence of careful history and physical and roentgen-ray exami-

nations *lend their support to such a diagnosis*. It is more often to be interpreted as mucosal congestion with diapedesis, or due to miliary erosions, and should lead to a careful examination of heart, lungs and liver and for obstruction in the portal circulation. I consider the finding of occult blood in the gastric filtrates as of much more importance than its demonstration in the gastric residues. The number of times that it appears in the fractional analysis also adds greater significance to its finding.

Finally I want to say a word about the diagnostic and prognostic value of repeated fractional gastric analyses. I have found this method of checking my findings of the greatest practical value (Figs. 81 and 82). It is especially useful in cases where repeated roentgen-ray examinations cannot be obtained, because it gives a very accurate picture of the motility of the stomach, as well as its secretory curve. It has also been of value in following the progress of medical treatment, and in estimating the benefit derived from surgical interference (Figs. 84 and 85). In many cases, with complete arrest of symptoms, it will be found that the fractional analysis has not returned to normal, and unless treatment is continued a relapse is quite likely.

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CHAPTER XIV.

DIAGNOSIS.—(CONTINUED.)

THE GROSS AND MICROSCOPICAL STUDY OF THE STOOLS.

FROM gross inspection the stool will often help to make a diagnosis of the condition with which we have to deal. The normal stool should be a solid cylinder 4 to 8 inches long, and the cross section should be about the diameter of a quarter or half dollar. When a stool is well formed and the size of a pencil or a finger, we can be pretty sure we have a *spastic* state to deal with. If the stool is a long cylinder, but of lead pencil size, it suggests spasm of a similar length of the sigmoid, but without hypersegmentation. If the first portion of the stool is thick and blunted, and the terminal end is flattened out or pointed, it suggests anal spasm. The flattened ribbon-like stool, if of the same general appearance over many days, suggests stricture of the terminal sigmoid or rectum, often due to new growth within or without the gut.

A large ball of compact feces, or a large cylindrical mass of $1\frac{1}{2}$ or 2 inches diameter, or larger, and 10 to 12 inches or more long, usually means *atony*. Also, the oft repeated formed stool, in incomplete evacuation, means atony. Conversely, the oft repeated liquid stool, in incomplete defecation, means spasm plus inflammation.

The small goat-like stools may mean spasticity but with associated hypersegmentation, and a conglomerate but cylindrical mass of these small balls will suggest a *mixed* type—spasticity higher in the colon and atony of terminal sigmoid or rectum.

In other words, the gross size and appearance of the stool mass is often representative of the caliber of the lumen of the lower bowel.

Again, the gross appearance of the stool may suggest the presence of catarrhal or inflammatory states of the gut, together with evidence directly pointing to intra-intestinal fermentation. For instance, a formed stool with adherent strands, or bands or shaggy shreds of mucus attached to its outer surface, almost invariably indicates a catarrh of the large bowel—a *colitis*. Occasionally the mucus may be passed as pellets, like tapioca, or in ropes which unfold in water like sheets, and are the mucous casts of the so-called mucous colitis, perhaps in certain cases of true neurogenic origin,

although I believe this more often may be an expression of a catarrhal inflammatory or bacterial infective state, if properly investigated. Again, a stool may show intimately mixed mucus, so that it gives a shiny, slimy mirror-like surface to the fecal mass, which is more often semi-liquid or mushy and very sticky. This type usually indicates a catarrhal inflammation or infection of the small bowel or an *ileitis*. These two types may be merged in certain cases, which show both intimately mixed and coarsely adherent mucus, and indicate an *ileo-colitis*.

The *color* and *size* of the stool may be very variable and subject to many changes in its response to the type of food eaten, and is often altered in these respects by true pathological states of the biliary, pancreatic and intestinal tracts. Stools from a carbohydrate or vegetarian dietary are apt to be larger in their bulk than those from a protein diet, depending, too, upon how much of the coarser cellulose foods they contain which will increase the amount of residue in the fecal matter. Such stools will vary in color according to the predominance of any one food which is eaten, but are not likely to contain as much bile as tints the proteid stool inasmuch as it is found experimentally that such carbohydrate test meals do not give rise to as much gall-bladder evacuation as do the protein test meals, when acted upon by an acid gastric juice (see page 107).

The carbohydrate-vegetarian stools are fluffier and as a rule more swollen with their gas content than are the protein stools, which are more compact, solid dark greenish-brown masses with a tendency to sink rather than float in the trap water.

Much in regard to the size of the stool will be found to depend upon the amount of fat ingested measured in terms of the biliary and pancreatic efficiency. When there tends to be failure in either of these two respects, but more particularly in pure pancreatic disease or insufficiency, the size of the stool is greatly increased due to its abnormal content of unsplit or split fats and soaps, which are readily detected on microscopical examination. Indeed the bulkiest stools occur in cases of pancreatic disease or in biliary obstruction, and in the former present a gray, greasy, semi-mushy appearance, and have usually a sour odor.

The stools accompanying complete biliary obstruction with jaundice rapidly lose their normal yellowish-brown coloring and become more and more distinctly gray or putty-colored in proportion to the degree of biliary obstruction. If the minor pancreatic duct of Santorini is still patent the stools do not take on the extreme characteristics of complete failure of digestion of fats as seen in the states of pancreatic disease described above, in which both

Wirsung's and Santorini's ducts are obstructed, and the stools are more apt to be constipated in type, harder and drier and less fluid or mushy than occurs in true pancreatic disease without biliary obstruction.

One gets a certain amount of useful information of a practical nature from observing the amount of *gaseous formation* roughly determined by whether the stools float or sink in the toilet trap water; from the *odor*, whether sour and fermentative, as in carbohydrate maldigestion, or pungent or putrefactive, as in proteid decomposition; and whether or not there are grossly recognizable *undigested food* elements. The latter will give us certain rapid clinical deductions in regard to the rate of intestinal motility if inquiry is directed as to when the recognizable food elements were eaten.

It is sometimes useful in an investigative way, although of no paramount practical importance, to determine accurately the quantitative gaseous content and its chemical composition by certain tests which can be found in standard monographs on the subject, but which are too detailed for discussion in a book of this character.

Also gross inspection of the stool may in certain cases reveal intestinal parasites; gall-stones may occasionally be recovered, more certainly after the stool is washed through a sieve; coproliths or fecaliths following occasional roentgen-ray examinations with barium or bismuth; or the pseudo gall-stones, really soap-stones, following the ingestion of much olive oil may be found and will give informative data.

The coloring of the stool will also be changed to a much lighter grayish-yellow color after an exclusive milk diet. Various medicinal agents, such as iron or bismuth, will color the stools a black-brown and closely resemble in color the stools produced by a massive gastric or high intestinal hemorrhage, or in a chronically bleeding duodenal ulcer by its steady and gradual blood seepage.

When we remember that 25 to 30 per cent of the dried fecal residue is made up of living or dead bacterial bodies we realize that the size of the stool may depend to a great extent upon the condition of the intestinal bacterial flora which makes up certain types of bacterial intestinal toxemias.

In this connection, and at this point, it may be well to refer to the excellent and interesting researches of Dr. N. P. Norman,(2) and since the expression of his conclusions as represented in his excellent paper so closely parallels my own, with his permission, I shall quote him at some length.

He divides his bacterial intestinal toxemias into two main groups and proceeds to discuss their findings as follows:

TYPES OF INTESTINAL TOXEMIA.

"1. Putrefactive toxemia:

(a) Indolic types with indicanuria.

(b) Indolic types without indicanuria.

(c) Butyric acid types with *B. aërogenes capsulatus* infection.

"2. Pyogenic infection toxemia.

"*The putrefactive types* may or may not be associated with pyogenic infections; however, a combination of the two types is frequent. In the indolic type of putrefactive toxemia, it has been our observation that there may or may not be an excessive indicanuria and for this reason we divide the indolic type into two classes, with and without indicanuria. The indolic type showing indicanuria is most usually associated with some degree of ileocecal valve incompetency, this defect allowing the regurgitation of cecal contents into the ileum. When this occurs, great numbers of bacteria are being constantly thrown into the lower part of the ileum from the cecum and the colon bacillus finds a fertile pabulum, relatively carbohydrate-free, for their growth. On such media, the colon bacillus is a very active and prolific indol former. This occurs in a portion of the small intestine where absorption is rapid and the cleavage processes of the liver are broken down by overwork with resulting excessive indicanuria, and in some cases acetonuria. We have clinical proof that this is true, for we have reduced the indicanuria by feeding the patient a lactose or dextrine laden diet; these sugars, because of being slowly absorbed, are to be found in the ileum and colon, and their presence changes the colon bacillus from a putrefactive to a fermentative type. It has been demonstrated in the laboratory that the colon bacillus, when grown on a carbohydrate-free medium, will produce indol, but the addition of a carbohydrate to the medium suppresses the indol forming characteristic. In the indolic type of putrefactive toxemia without indicanuria, the ileocecal valve is intact and diminishes the number of bacteria that pass upward into the ileum from the cecum and explains the relatively low indican index in some cases of manifest clinical autotoxemia. The fact that the liver may be very active and able to completely destroy indol must be borne in mind in the indican-free cases.

"The butyric acid type of putrefactive toxemia is characterized by a Gram-positive flora predominated by sporulated and non-sporulated types of *Bacillus aërogenous capsulatus* which is an anaërobic, spore-forming organism with hemolytic properties, capable of living on either a carbohydrate or protein residue. It is able to produce gas on either pabulum. As a rule, this bacillus, when the environment is favorable, seems almost to annihilate all

the helpful organisms of the intestinal tract, that is, the aciduric forms and the colon bacillus. This organism is usually associated with pyogenic infection. In this type of toxemia, indican may be very slight or absent, depending upon the fate of the colon bacillus. Great amounts of acids are produced, mostly butyric, with others of secondary importance, as caproic, valeric and propionic. At times, the fatty acids are neutralized by bases which are formed during the course of putrefaction; this is specially true of ammonia, which forms ammonium butyrate in excess. (1) Ammonium butyrate is a distinct intestinal irritant and produces a diarrheal condition not infrequently observed in this type of infection. It seems logical to ascribe the occurrence of aërogenous capsulatus infection as part of the pathology of virulent pyogenic infection which thickens the intestinal mucosa and in this wise inhibits the normal interchange of gases (3) between the intestinal cavity and blood stream. When the colon is freely drained and the aciduric forms are established, the intestinal mucosa is given a chance to heal and the interchange of gases is increased. When this occurs, the absolute anaërobic condition of the colon is altered and the laboratory picture shows that the gas bacillus changes from the non-sporulated state to the sporulated, evidence of an unfavorable environment having been created. This type of infection is very hard to deal with, especially from a dietary point of view.

"By pyogenic infection, we mean those due to the pyogenic cocci which we have found so frequently associated with one of the putrefactive forms of toxemia. The pyogenic foci occur in the lymph follicles, Peyer's patches, lymph nodes, mesenteric nodes and intestinal mucosa. In fact, intestinal putrefaction so alters the protective secretions of the intestinal tract as to allow infection from the upper digestive tract to gain lodgment in the previously mentioned structures of the small intestine and the colon. For this statement, we have pathological, bacteriological and clinical proof.

"The pathological changes are usually hyperplasia of the intestinal chain of lymphatics far in excess of the hyperplasia found in lymphatics of the upper digestive tract. There is a diffuse infiltration of the intestinal mucosa with lymphocytes, eosinophiles, plasma cells and in some instances areas of polymorphonuclear infiltration forming small abscesses. In some instances, cystic glands are noted. In the more chronic cases, the submucosa is fibrous and shows hyperplastic lymph follicles and diffuse infiltration of mononuclear cells, as found in chronic appendicitis. Soon the muscular coat shows inflammatory infiltration with fibrosis and a loss of smooth musculature. The fibrosis causes a loss of elasticity of the intestinal wall, which results in intermittent dilatation of the

intestines, produced by constipation, which in turn finally produces a chronic dilatation and thinning of the colon wall. Finally the inflammation extends to the serosa and there produces adhesions and the drainage of the infective substances to the spleen and liver causes fibrosis in these organs. These lesions were noted at autopsy on infected cases.

"Bacteriological proof is found in the isolation of bacteria from colonic drainage and in autopsy cultures of mesenteric nodes. In numerous instances we have noted identical bacteria in these localities as were found in the teeth and the tonsils.

"Clinically, intestinal infection produces a multitude of disorders and diseases. The more common types of diseases associated with infections of the digestive tract are: cardiovascular-renal conditions; arterial diseases; essential high blood-pressures, low blood-pressures; the rheumatisms; some forms of eczema; some forms of asthma; some indefinite disorders, as the so-called neurasthenic and psychasthenic states; neuritis; some forms of neuralgia; malnutritional states; some forms of obesity; diabetes; postinfluenzal asthenias; chronic constipation; auto-intoxication syndromes; subacute or chronic appendicitis; certain ocular conditions; protracted convalescent states, either from acute diseases, or operations, or pregnancies; chronic cholecystitis; hemorrhoids; syndromes characteristic of visceroptosis; mucous colitis; and the various indefinite digestive disorders."

RESTORING THE BIOLOGICAL FUNCTION OF THE LOWER DIGESTIVE TRACT.

"The restoration of the biological function of the lower digestive tract presumes the removal or correction of foci of infection in the upper tract. Infections of the gall-bladder have been studied by Lyon (4) (5). Our experience in gall-bladder infections has not been very extensive, but has led us to believe that free drainage of the colon will indirectly drain the gall-bladder, by hastening the activities of the functions of the small intestine. This obviates in these cases, the intraduodenal method, and accomplishes in one operation not alone a gall-bladder drainage, but also a colon drainage. There is no attempt to minimize gall-bladder drainage through the intraduodenal method, as we recognize the value of this method in furnishing direct evidence for establishing a correct diagnosis, as well as its adaptability as a therapeutic measure, which bids fair to rob surgery of its oftentimes inadequate method of dealing with these types of infection. Duodenal drainage should always be combined with colon drainage in those cases in which the gall-bladder infection is not relieved by colon drainage, this statement being

based upon the universal association of gall-bladder infections with colon infections.

"The principles of treating pyogenic infections and putrefactive toxemias of the lower digestive tract resolves itself into five factors:

- "1. Mechanical drainage of the colon.
- "2. The changing of the biological processes by rectal and oral implantation of the protective forms of bacteria.
- "3. Maintaining a permanent normal bacterial flora.
- "4. Autogenous vaccines in selected cases.
- "5. Exercises."

I doubt very much that drainage of the colon "will indirectly drain the gall-bladder," because, as I have shown (see discussion on page 128), many substances or chemical solutions when introduced directly into the duodenum fail to do so. It may be that if the colon were washed with a magnesium sulphate solution this might tend to partially evacuate the gall-bladder, due to a certain portion of this salt being absorbed into the blood stream. This has been suggested as possible by my experiments with magnesium sulphate introduced into the rectum. So, too, this salt of magnesium might act in such a manner if introduced intravenously. Nevertheless in both of these possible methods of introduction we would lose our chief advantage of duodenal drainage both diagnostically and therapeutically, for in the latter case I believe much of our beneficial therapeutic results are accomplished by removing *from the body* the poisoned or infected bile drained from the liver and gall-bladder so that it is not partly reabsorbed (bile salts) by the mesenteric lymph and blood supply and carried by the portal vein back to the already damaged liver cells and thereby increase their toxemia.

However, I am very much in accord with Norman's point of view as to the additional benefit we can secure for our patients in detoxicating them through drainage of the gall-tract, a large part of the poisoned material being removed directly from the body, and the balance *hurried* through the intestines by using Jutte's method of transduodenal lavage, and finally, by drainage of the colon by this more complete and rational method advanced by Norman.

THE CLINICAL STUDY OF INTESTINAL MOTILITY.

One of the best single and practical methods of obtaining information as to the intestinal motility and gross aspects of the stools may be gained by combining a motor test with some coloring agent to

demarcate any individual meal, with a charted report, made by the patient, of certain gross appearance of the stool. My custom is to give the patient two 5 grain capsules of carmine, which are to be taken midway in the meal *next following* a bowel movement, and the hour and date when it is taken is to be charted. Thereafter he must inspect each succeeding stool and keep a record of the hour and date of its passage, and chart its form, color, consistency, amount, odor and whether or not there is visible mucus or undigested food, and whether or not the stool floats or sinks. This gives information as to the rate of motility of any given meal passing from stomach to toilet, whether the bowel empties it in one movement within normal time limits of twelve to twenty hours, or in several movements over a period of days, indicating stasis due to spasm or atony, adhesions, angulations, or malpositions of the intestinal tract which must then be differentially diagnosed. Just this demonstration of stasis permits us to then speculate more intelligently in regard to absorption of toxins, chemical or bacterial, creating a picture of autotoxemia, which may be behind the seemingly functional or so-called neurasthenic state of the patient. By the selection of certain tests a correct differential diagnosis may finally be arrived at. This simple motor carmine test also gives us a record of observation by the patient of several consecutive stools, and one or more of them is then brought in or obtained fresh in the office for further detailed microscopical and chemical examination.

The chart devised as most practical for this purpose, is found on pages 278 and 279.

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NAME,	DATE,	
	THIS REFERS TO TIME	
	1st	2d
Description of Bowel Movements.		
DATE and HOUR A.M. or P.M.		
COLOR —Red, brown, red and brown, yellow-brown, etc.		
FORM —Sausage, small, balls, long string, pencil, flattened ribbon, mushy, liquid.		
AMOUNT —Roughly in tea-cupfuls, table-spoonfuls, etc.		
MUCUS —Jelly-like masses, skin-like strings, or sticky and glistening.		
UNDIGESTED FOOD — Hulls of corn, beans, peas, seeds or fruit skins.		
ODOR —Sour, putrid, pungent, very offensive.		
FLOATS OR SINKS — Completely cover with water; shake free of sticking to bottom.		
SUMMARY (Do not write on this line),	Appearance,	Hours.

CHAPTER XV.

DIAGNOSIS.—(CONTINUED.)

QUANTITATIVE DETERMINATION OF ENZYME ACTIVITY IN DUODENAL FLUIDS.

BY OLAF BERGEIM, M.S., PH.D.

DUODENAL fluids may be mixtures of bile, pancreatic, intestinal and gastric juices with foods or other substances which have been ingested. With proper methods of collection, however, we obtain chiefly a mixture of pancreatic juice and bile. Bile may contain very small amounts of amylolytic and proteolytic enzymes. These are not, however, significant. The predominating enzymes found in duodenal contents are those of the pancreatic secretion. These are trypsin, lipase (steapsin), and amylase (amyllopsin). The milk-coagulating activity of pancreatic juice is apparently a property of trypsin.

Amylase is secreted by the pancreas in the active form. Trypsin and lipase are secreted to a considerable, but variable, extent in the inactive or zymogen forms as trypsinogen and steapsinogen. The trypsinogen is converted into active trypsin by a substance found in the secretion of the duodenal mucosa and called entero-kinase. The steapsinogen is activated by the salts of the bile.

Aside from its activation of the fat-splitting enzyme, bile further augments the action of all three enzymes. It assists in fat digestion by aiding in the emulsification of fats and in the absorption of fatty acids through the intestinal wall. For these properties the bile salts appear largely responsible. Bile further exerts a protective action on lipase tending to prevent its destruction by trypsin (Fenger and Hull). (9) It protects trypsin from the destructive action of pepsin through its power to neutralize the acid chyme coming into the intestine as well as through a direct precipitating action (Babkin). (2) Bile further augments the action of amylase to some extent, probably through its content of chlorides and also protects this enzyme from trypsin.

All three enzymes are readily influenced in their activities by alterations in the reactions of the digestion mixtures and their content of inorganic salts. All are relatively unstable. Lipase is especially sensitive and the fat-splitting activity of duodenal

fluids is soonest lost. Amylase remains next longest unaltered and trypsin is the most stable.

All of these influences must be borne in mind in the determination of the enzyme concentration of duodenal fluids.

Numerous methods have been suggested for the *determination of trypsin*. Among these may be mentioned Roaf's (25) modification of the method of Grützner based on the digestion of Congo-red fibrin and estimation of the color set free; Mett's (21) method based on the digestion of tubes of coagulated egg albumen, Einhorn and Rosenbloom's (8) method using gelatine tubes, Einhorn's (7) method employing hemoglobin-agar tubes and Löhlein's (18) modification of the Volhard method in which the degree of digestion of a casein solution is estimated by titration of the mixture with alkali after first adding a measured amount of acid. Fermi (10) determined the amount of trypsin solution required to digest a measured amount of 5 per cent gelatine to the point where it no longer solidified on cooling. Somewhat similar was the method of Müller and Jochmann (22) based upon the liquefaction of Löffler blood serum plates. The Fuld-Gross (13,15) procedure was based upon the digestion of definite amounts of casein solution to the point where a precipitate was no longer given with acid-alcohol. This procedure was modified by W. H. Spencer, (29). Other methods have been based upon the determination of alterations in the digestion mixture of its viscosity (Spriggs), (31) electrical conductivity (Bayliss), (4) refractive index (Robertson) (26) or optical activity (Abderhalden). (1)

McClure, Wetmore and Reynolds (20) determined the degree of digestion of a casein solution by precipitating undigested casein with metaphosphoric acid and estimating residual nitrogen by the Folin-Wu (12) procedure. Gaultier, Roche and Baratte (14) and more recently Damade (6) have estimated trypsin by permitting it to act upon a gelatine solution and estimating the degree of digestion by a formaldehyde titration. The most flexible and simple of these appears to be the last mentioned formaldehyde titration procedure and this is the basis of the technic suggested by Lueders and Bergeim, (19) and described in detail in the present chapter.

Amylase has been determined most commonly in one of two ways. The amount of maltose formed has been estimated by a reduction method, or the time required for the disappearance of the starch-iodine reaction has been followed. Among the reduction methods are those of Bang (3) using an hydroxylamine solution in titrating; Lintner (17) and Einhorn and Rosenbloom (8) using Fehling's solution; Sherman, Kendall and Clark (28) using a copper iodide method; and of Gaultier, Roche and Baratte (14) using the method

of Grimberty. Lueders and Bergeim (19) have suggested the use of Benedict's solution (for details see latter portion of this chapter).

Wolgemuth (33) has described a method based upon the disappearance of the starch-iodine reaction; Pollak (24) and Chrzaszcz (5) methods based on the liquefaction of starch; Fernbach and Wolff (11) a method based on viscosity determinations; and McClure, Wetmore and Reynolds (20) have used the Folin-Wu (12) blood-sugar method for determination of the maltose formed. Einhorn (7) has suggested the use of starch-agar tubes in a manner similar to that employed in Mett's (21) method for pepsin.

Lipase has been determined most commonly by titration of the acid set free through its action. As substrates Kanitz (16) used a simple oil emulsion made by shaking olive or castor oil with alkali, while Palmer (23) and McClure, Wetmore and Reynolds (20) used pharmaceutical emulsions of olive and cottonseed oils respectively. Lecithin has been used by Gaultier, Roche and Baratte, (14) egg yolk emulsion by Volhard and Stadel, (32) monobutyrin by Rona and Michaelis, (27) and ethyl butyrate by Damade, (6) Einhorn and Rosenbloom (8) and others.

Pharmaceutical emulsions of olive or cottonseed oil are very satisfactory and readily available. An emulsion of this type is employed in the method of Lueders and Bergeim (19) which is given in detail in this chapter. Titrations of the fatty acids set free are not readily made in aqueous solution. Alcohol or alcohol-ether mixtures have therefore been generally used.

Almost any of the methods mentioned above can be used in the determination of the enzyme activity of duodenal fluids. Most are, however, too time-consuming when many analyses are to be carried out at a time as in fractional examinations of duodenal contents. The method of Lueders and Bergeim (19) given below has the advantage of *simplicity*. Of earlier methods it follows most closely that of Gaultier, Roche and Baratte. (14) It was developed in connection with studies of duodenal secretion carried out in collaboration with Drs. M. E. Rehfuss and P. B. Hawk. The author desires to thank the foregoing, as well as Dr. Lueders, for permission to refer to this work which will appear shortly in the *American Journal of the Medical Sciences*.

THE METHOD OF LUEDERS AND BERGEIM FOR THE DETERMINATION OF TRYPSIN, AMYLASE AND LIPASE IN DUODENAL FLUIDS.

Reagents. 1. *Gelatine Solution*, 5 per cent. Dissolve 50 gm. of highest grade culture media gelatine in a liter of distilled water in a large beaker over a Bunsen burner. The temperature of the

water should be kept below 60° C., to prevent scorching of gelatine. Stir continuously until gelatine solution is homogeneous. Pour carefully into a clean, previously heated bottle (to prevent cracking) and add toluene to cover gelatine solution with $\frac{1}{4}$ -inch layer. Keep in a warm place.

2. *Soluble Starch Solution*, 5 per cent. Stir 50 gm. of soluble starch up into a smooth paste in a mortar after adding slowly 50 cc of cold distilled water. Heat to boiling 950 cc of distilled water and add to this, with continuous stirring, the starch until a homogeneous mixture results. Pour carefully into a clean, previously heated bottle and add toluene to cover the starch solution with $\frac{1}{4}$ -inch layer. Keep at room temperature.

3. *Olive Oil Emulsion*, 20 per cent. There are required 30 gm. of gum acacia, 60 cc of distilled water, and 120 cc of best quality olive oil. Place the acacia in a mortar, add the oil, rub into smooth paste, always stirring in one direction. When a thick, homogeneous paste results, add, all at once, the 60 cc of water and continue stirring until a milk-white emulsion is formed. Measure into a graduated cylinder and add distilled water with repeated washing of mortar until 600 cc of emulsion is made. Add 1 cc of 40 per cent formalin as preservative. Keep in ice chest.

4. *Formol-alcohol Solution*. Mix equal parts of 95 per cent alcohol and 40 per cent formaldehyde solution. Make neutral to phenolphthalein with concentrated NaOH, added drop by drop, to faintest pink color.

5. *Alcohol-ether Solution*. Five parts of neutral 95 per cent alcohol and 1 part of acid-free ether are mixed fresh for each day's determinations. Of this mixture, made neutral with $\frac{N}{10}$ NaOH, 10 cc are used in each test.

6. *Benedict's Sugar Reagent*.

Copper sulphate (crystallized)	18 grams
Sodium carbonate (one-half the weight of the anhydrous salt may be used)	200 "
Sodium or potassium citrate	200 "
Potassium thiocyanate	125 "
Potassium ferrocyanide (5 per cent solution)	5 cc
Distilled water to make a total volume of	1000 cc

With the aid of heat dissolve the carbonate, citrate, and thiocyanate in enough water to make about 800 cc of the mixture and filter if necessary. Dissolve the copper sulphate separately in about 100 cc of water and pour slowly into the other liquid with constant stirring. Add the ferrocyanide solution, cool, and dilute to exactly 1 liter. The copper salt only need be weighed with exactness.

Technical Procedure.—(a) Prepare three 50 cc Erlenmeyer flasks, marked "T," "A" and "L" (trypsin, amylase, lipase).

(b) To flask "T" add 20 cc of 5 per cent solution of gelatine. (1) To flask "A" add 20 cc of 5 per cent solution of soluble starch. (2) To flask "L" add 5 cc of 20 per cent emulsion of olive oil. (3)

(c) To each flask add 1 drop of phenolphthalein solution (1 per cent alcoholic solution); add to each flask, by means of Ostwald pipette, 1 cc of duodenal fluid.

(d) To each flask add, drop by drop, from a burette $\frac{N}{10}$ NaOH until a light pink color is produced which persists on shaking.

(e) To flask "A" add, drop by drop, from a burette, $\frac{N}{10}$ H₂SO₄ until the first disappearance of pink color; incubate flasks for one hour at 37° C., shaking the flasks every fifteen minutes.

(f) Upon removal from incubator place "T" and "L" flasks in ice water and add to the "A" flask a small amount of sodium carbonate, to stop digestion.

(g) Controls of boiled duodenal fluid, plus gelatine, starch and oil, treated as above stated, must be incubated with the three test flasks and correction for these blanks made.

Tryptic Activity. Formol Titration. Add 5 cc of neutral formol-alcohol solution. (4) Titrate again to the first light pink color with $\frac{N}{10}$ NaOH. From the burette reading subtract the blank reading. The result is a measure of the peptones, amino-acids, etc., formed by the action of the trypsin of 1 cc of the duodenal fluid upon 1 gm. of gelatine.

Lipolytic Activity. Add 10 cc of neutral alcohol-ether solution. (5) Titrate to neutrality with $\frac{N}{10}$ NaOH (first light pink color). Take the burette reading. Subtract the blank reading. The result is a measure of the fatty acids formed by the action of 1 cc of duodenal fluid upon 1 cc of olive oil for one hour at 37° C.

Lipase appears to require, for its proper action, the presence of some constituent of the bile. Where, therefore, as in certain liver and gall-bladder disturbances, there is a restricted flow of bile into the intestine, 1 cc of fresh ox bile or a small amount of the mixed bile salts in powder form (Fairchild and Foster's bile salts were found satisfactory) should be added to the digestion mixtures in carrying out the lipase determination.

Amylolytic Activity. Pour the digestion mixture into a 10 cc burette and run slowly, then drop by drop, into 5 cc of Benedict's reagent, (6) plus 0.5 gm. of sodium carbonate heated to boiling in a large test tube until the last trace of blue color disappears. The burette reading, divided into 0.0149 (the number of grams of maltose required to reduce 5 cc of Benedict's reagent), gives the amount of maltose in 1 cc of the digestion mixture. Multiply by 20 to obtain the total amount of maltose formed.

Duodenal contents should be titrated for acidity or alkalinity as a routine procedure. When phenolphthalein is used as an indi-

cator it must be borne in mind that entirely neutral duodenal fluids will give appreciable titrations with this indicator, which changes color only in distinctly alkaline reaction. Damade (6) titrates using methyl orange and obtains values of 1.4 to 12.5 cc of $\frac{N}{10}$ hydrochloric acid for 10 cc of duodenal contents.

Determination of the enzyme contents of duodenal fluids should be made as soon as possible after collection of the specimens as the enzyme activity decreases markedly on standing even in an ice box. At room temperature G. F. Spencer (30) found in certain cases a loss of about 50 per cent of the lipase in twenty-four hours. Amylase was fairly constant for twenty-four hours and trypsin for forty-eight hours. If gastric juice is present in samples deterioration may be much more rapid.

Spencer (30) has also studied by the above technic the enzyme concentration of duodenal fluids collected by the fractional method following protein, fat and carbohydrate meals. On *normal* individuals he obtained values for trypsin of 2 to 6 cc, for lipase 1 to 9 cc, and for amylase 0.10 to 0.50 gm. of maltose. Wide variations have been found in pathological conditions. *Persistent low values* would be indicative of *pancreatic disease*. Considerable more work must be done on specimens obtained under carefully standardized conditions before definite figures can be assigned to any given pathological condition. Caution must be used in interpretation of results obtained until this more definite basis has been established.

The author desires to thank Dr. G. F. Spencer for permission to refer to unpublished data.

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CHAPTER XVI.

DIAGNOSIS.—(CONTINUED.)

FUNCTIONAL TESTS OF THE LIVER.

THERE have been a great many different tests advanced, especially in the past decade, for determining the functional capacity of the liver. None of those so far advocated have been entirely satisfactory from a clinical standpoint. The whole question of hepatic function is one of great complexity. One of the greatest objections to almost all tests lies in the fact that an attempt is made to determine the functional efficiency of the liver as a *whole* by testing its excretory power, which is only one of its many functions. Other major objections are that in most of the tests the procedures are very complicated and require highly specialized laboratory training and equipment; furthermore the function being tested is not confined entirely to the liver, but is also the property of some other organ or tissue.

No attempt will be made here to discuss in any detail the various procedures that have been advocated up to the present time, with the one exception of the several modifications of the phenoltetrachlorophthalein test for hepatic function. It will be sufficient at this time simply to mention some of the more important ones; namely, testing of the urine for urobilin, which is supposedly increased in proportion to destruction of liver parenchyma; determination of the amount of fibrinogen in blood plasma; determination of the amount of lipase in the blood serum; study of the amino-acid output and the nitrogen partition; various tests based on decrease in ability to handle carbohydrates; Widal's "hemoclastic shock" test.

THE PHENOLTETRACHLOROPHTHALEIN TEST.

This drug was first prepared by Orndorff and Black,(8) and the first full description of its pharmacological properties was given by Abel and Rowntree.(2) They found that there were no untoward symptoms following its intravenous injection as a disodium salt, well diluted; that it was excreted principally through the bile by the activity of the hepatic epithelium, and that it was reabsorbed only by the colon.

In 1913, Rowntree, Hurwitz and Bloomfield (11) urged its use

as a test for hepatic function in man. They worked entirely with the feces, saving all dejecta giving a pink color on the addition of alkali and estimating the total amount of dye eliminated in this manner. This method had several disadvantages aside from the time consumed and the disagreeable task of handling the material, since there was the question of the destruction of the dye in the intestinal tract and of resorption in the colon. They also demonstrated experimentally that injury to the liver parenchyma caused a fall in the amount of dye eliminated, and that the amount of dye eliminated varied inversely to the amount of liver destruction. This work was confirmed by Whipple; (13) Sisson; (12) Chesney, Marshall and Rowntree; (3) and Krumbhaar; (5) but McLester (6) and Kahn and Johnson (4) found no constant relation between the amount of dye eliminated and the amount of pathology in the liver.

In 1916, McNeil (7) used the duodenal tube for collecting the dye following its intravenous injection. He noted the time of the first appearance of the dye and also estimated the total amount eliminated over a period of two hours. He noted that the chief disadvantage of this method was the intermittent discharge of bile into the duodenum.

Up to this time the dye used had to be prepared fresh each time. This limited its use to institutions with adequate laboratory facilities. It was not until 1921 that Aaron, Beck and Schneider (1) prepared a stable solution of the drug.* With this drug they also introduced a modification in McNeil's technic, whereby a constant drip was obtained from the duodenal tube.

METHOD OF AARON, BECK AND SCHNEIDER.

Their procedure in brief was as follows: A duodenal tube is passed through a fasting stomach and when the tip is definitely located in the duodenum, 500 cc of cool water is given by mouth. With the patient on his right side a continuous drip of from 60 to 80 drops per minute is established. One cc of solution representing 50 mg. of dye is then injected intravenously. The drip is then allowed to run into a white porcelain dish containing a 40 per cent solution of sodium hydroxide. The initial appearance of the dye is indicated by a faint purplish-red ring at the point of contact of the drip and the alkali. This color gradually deepens until it reaches its maximum. At this point they take their readings. From their series of cases they conclude that the average appearance time in 16 cases is seventeen and two-tenths minutes. If the time of the first appearance of the dye is more than twenty

* This can now be obtained from Hynson, Wescott & Dunning, of Baltimore.

minutes they believe a suspicion of hepatic involvement is justified. They do not believe that the estimation of the amount of dye excreted in a given time is of any value.

METHOD OF PIERSON AND BOCKUS.

Piersol and Bockus (9) in a series of 50 cases studied the first appearance time, the maximum color intensity and the amount of dye eliminated in two hours. Their general technic differed from Aaron's only in that they injected 150 mg. of the dye instead of 50 mg. They collected all the bile eliminated over a period of two hours, each half hour's output being collected in a separate white basin containing 2 to 3 cc of 40 per cent sodium hydroxide. The dye excreted is separated from the bile and the amount estimated by a simple colorimetric method.

Technic for Precipitation of Bile Pigments.—1. Take each half hour's output and add enough sodium hydroxide to bring out the maximum intensity of color. Usually the original 2 or 3 cc is sufficient. Avoid excess of alkali. Dilute up to 1000 cc with water. Take 100 cc of this and add 3 cc of saturated solution of basic lead acetate and 2 cc of saturated solution of calcium chloride. Put in a flask and heat in a water bath until a precipitate is agitated. Filter and compare with standards.

Standards are prepared to represent 0.1, 0.2, 0.3, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 20 and 25 mg. of dye in 1000 cc of water. The unknown sample is compared with these by direct inspection in a good light.

From their investigations they believed that in this method they had a means of measuring the functional capacity of the liver when it was clinically negative to other methods of examination, and that the *quantitative* two-hour output was of more significance than the maximum color time. They found that in 15 normal cases the average appearance time of the maximum color was eleven and six-tenths minutes.* In 10 cases with grossly pathological livers it was twenty-three and two-tenths minutes. The output of dye over a period of two hours in the normal series averages 22.4 mg., in the grossly pathological cases 2.7 mg. It will be noted that the differ-

* This is at considerable variance from the "normal" figures reached by Aaron, Beck and Schneider, being six and a half minutes faster.

ence between the normal and the pathological series is four times greater for the amount of dye eliminated than for the maximum color point.

ROSENTHAL'S METHOD.

The third technic for the estimation of the functional capacity of the liver by means of phenoltetrachlorophthalein is that of Rosenthal. (10) His test is based on the ability of the liver to remove the dye from the *blood stream*. He found that normally the dye leaves the plasma rapidly and with great uniformity. Striking degrees of retention in the plasma were found to exist when liver damage was produced experimentally by chloroform and phosphorus poisoning.

The method of procedure is as follows: "The patient is weighed and 5 mg. of phenoltetrachlorophthalein per kilo body weight is drawn up into a 30 cc syringe and physiological salt solution drawn up to the 30 cc mark. With a needle of moderate bore, a superficial vein of the arm is entered, and about 8 cc of blood is allowed to run into a clean, dry test tube. Through the same needle the diluted dye is injected, and the time of completion is noted. From 20 to 30 cc of physiological sodium chloride solution is then drawn into the syringe and injected through the same needle, in order to wash the vein wall free of dye.

"With a small needle (a large hypodermic size may be used), and a syringe which has been washed in physiological sodium chloride solution, from 2 to 4 cc of blood is withdrawn from a vein of the opposite arm at fifteen minutes after injection, and again at one hour. Later samples may be taken if indicated by the findings in the hour sample. Special care must be taken not to use salt solution or needles that have been in contact with the dye, as it is easily decolorized, and, in the colorless state, may contaminate the bloods in which the dye is to be determined.

Determination of Percentage of Dye in Plasma.—"The bloods drawn are allowed to clot in the test tubes and then centrifuged. Anticoagulants have not been used because they occasionally cause hemolysis, and this procedure has been found equally accurate. The plasma is pipetted off into separate small test tubes of uniform size, and 1 drop of 5 per cent sodium hydroxide for every cubic centimeter of plasma is added to each tube. Ten mg. of phenoltetrachlorophthalein is now added to 100 cc of water. This strength has been arbitrarily chosen as a standard for comparison because it represents the approximate concentration that would be reached if all the injected dye remained in the plasma. Therefore the per-

centages express how much of the total amount of phenoltetrachlorophthalein injected is present in the blood stream. The milligrams of dye for each 100 cc of plasma may be derived by dividing the percentages by 10. With the sample of plasma obtained before the injection of dye, which should, of course, be clear, a series of standards is prepared in small test tubes of similar size, as in the accompanying table.

"The plasma in which the amount of dye is to be determined is now matched with these standards, using naked eye comparison in a good light. Artificial light is less satisfactory than daylight.

" PREPARATION OF SERIES OF STANDARDS.

" 0.2 cc	0.2 cc	0.2 cc	0.2 cc	0.2 cc	0.2 cc
100 per cent	80 per cent	60 per cent	40 per cent	20 per cent	12 per cent
Standard	Standard	Standard	Standard	Standard	Standard
solution	solution	solution	solution	solution	solution
0.6 cc.	0.6 cc.	0.6 cc.	0.6 cc.	0.6 cc.	0.6 cc.
Plasma	Plasma	Plasma	Plasma	Plasma	Plasma
25 per cent	20 per cent	15 per cent	10 per cent	5 per cent	3 per cent"

In a series of 20 cases, 10 of whom were physically normal and 10 with extra-hepatic disease, Rosenthal found strikingly uniform results, from a moderate trace (2 per cent) to 6 per cent was present at the fifteen minute interval and practically complete disappearance of the drug within from forty to sixty minutes.

In his series of pathological cases, including 5 with carcinoma of the liver, 3 with cirrhosis, and a number of miscellaneous cases, including acute yellow atrophy, acute hepatitis and toxemia of pregnancy, he found marked retention of dye. In these cases there was up to 20 per cent retention at fifteen minutes and the dye had not left the blood plasma in five hours.

Considerable further work must be done and larger series of cases collected before a final estimation can be made of the value of phenoltetrachlorophthalein as a liver functional test, but prospects are now favorable for the development of a simple technic giving reliable results.

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CHAPTER XVII.

DIAGNOSIS.—(CONTINUED.)

ABBREVIATED DESCRIPTION OF THE TECHNIC FOR NON-SURGICAL DRAINAGE OF THE GALL-TRACT.

Step 1. Patients present themselves at the office at 8 to 9 A.M. on a twelve-hour fasting stomach following a motor test meal, which includes a meat sandwich (any kind of meat or fowl desired), and either six stewed prunes or about twenty raisins. With this meal the patient may drink any simple beverage, but after its completion nothing further is to pass the lips until after Step 2. On the morning of the examination the patient is not allowed to brush the teeth.

Step 2. Attempted disinfection of the mouth as follows:

(a) Thoroughly rinse and gargle mouth with a mild astringent solution containing zinc chloride and formalin.*

(b) Thoroughly rinse and gargle with 1 : 500 solution of potassium permanganate (1 grain to the ounce).

(c) Thoroughly rinse and gargle again with the astringent solution.

(d) Thoroughly rinse and gargle with sterile water.

Note. In cases having nasal catarrh, rhinitis or nasopharyngitis it is a good plan to spray and disinfect the nares as effectually as possible.

Step 3. A freshly sterilized duodenal tube is swallowed and passed to the greater curvature, *i. e.*, the first mark on the duodenal tube should be placed at 55 cm., which in the average case closely approximates the distance between the lips and the greater curvature of the stomach. During this step it is well to note and record whether the tube was taken easily, without nervousness, or coughing, or the development of a gag reflex, inasmuch as these occurrences modify in certain directions the proper interpretation of the fasting gastric residuum due to biliary regurgitation. (See page 257.)

Note. In patients in whom one wishes to limit the study chiefly to the more accurate determination of the bacteriology of the duodenum and gall-tract, I find it advisable before passing the sterile tube to attempt the "disinfection" of the esophagus by having the patient swallow 100 cc of a 1 to 1000 solution of potassium per-

* For formula see page 301.

manganate or of freshly prepared silvol, and after this pass the duodenal tube and drain out or aspirate by syringe as much of this solution as possible before proceeding to wash the stomach. Having made use of this step it is obviously impossible to make any accurate study of the chemistry of the fasting gastric juice.

Step 4.—The fasting gastric residuum is extracted by gravity or by syringe aspiration into a conical graduated glass vessel. Its amount, its color and its gross consistency and characteristics should be carefully noted and recorded. In addition to the total

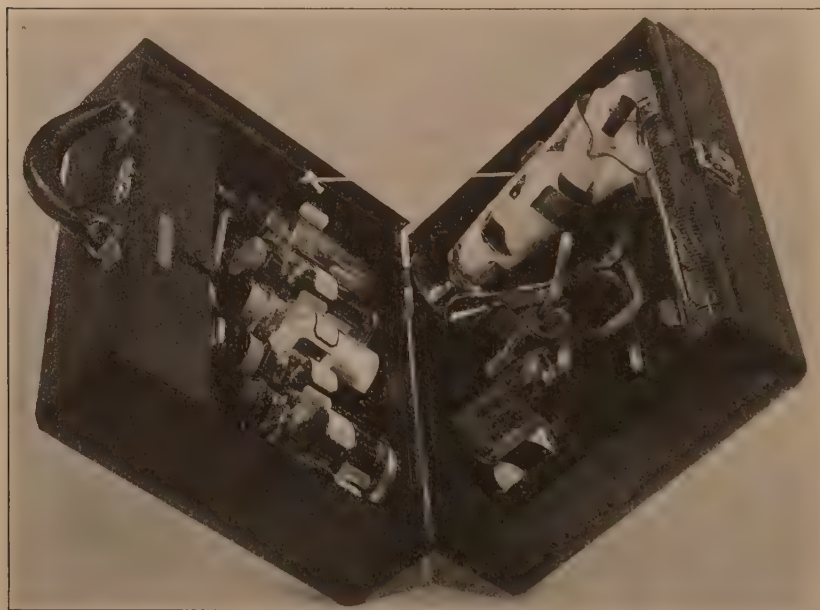


FIG. 97.—Represents a practical travelling bag equipped with the necessary apparatus for performance of a diagnostic or therapeutic drainage of the biliary passages which can be taken to the home or hotel.

amount the relative proportion of the sediment to the supernatant fluid contents should be independently recorded. The sediment is then examined microscopically in fresh preparations stained and unstained, and the filtrate is tested for free and total acids, and both filtrate and sediment tested for the presence of occult blood with guaiac and benzidene. (See pages 240 and 260.)

Step 5. The stomach is now thoroughly washed, astringed and disinfected. (For complete discussion see pages 305 to 307.)

(a) Washing the Gastric Mucosa. This is done by repeated douching with and withdrawal of 250 cc units of sterile water at

body temperature and continued until the wash water is returned sparkling clear. Attention is paid to and notes recorded of the number of 250 cc units required to clean off the surface slime on the gastric mucosa; of the amount and general gross characteristics

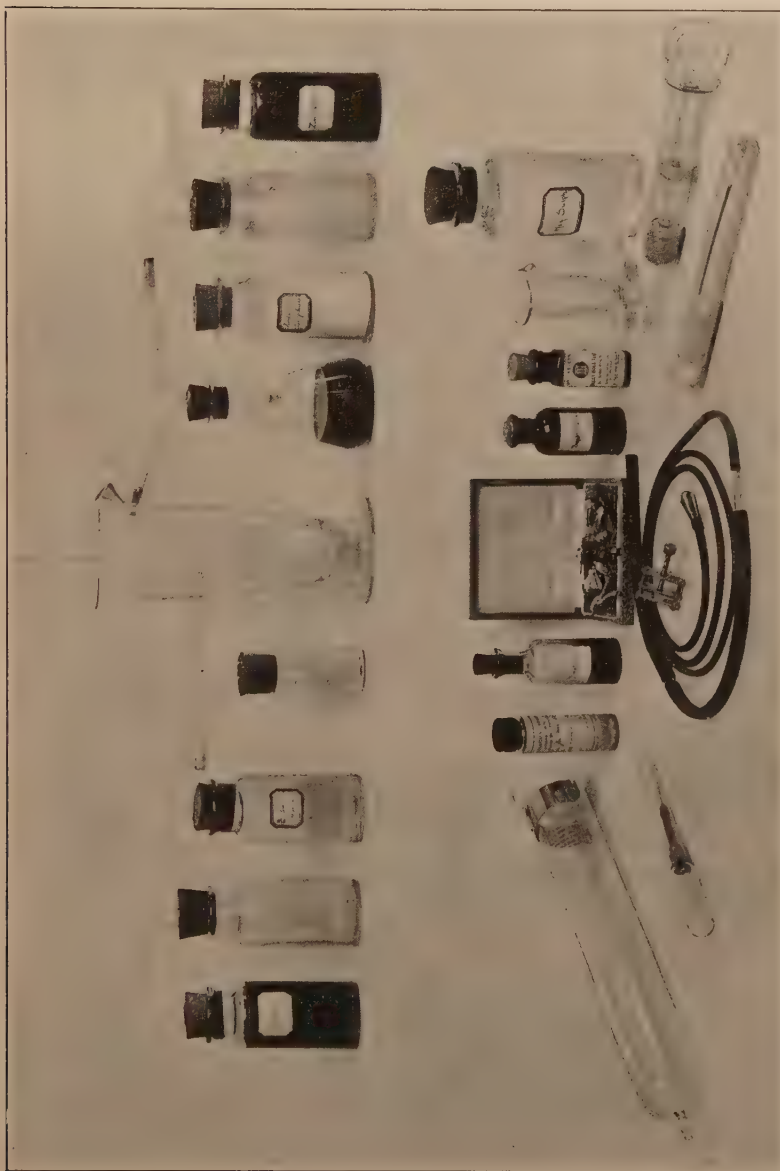


FIG. 98.—Shows contents of travelling case. Note particularly the collection of various duodenal tips which are of use in certain difficult cases; note the sterile tonsil swab; note the Keidel tube for blood Wassermann.

of the mucus flocculations recovered; of the occurrence of biliary regurgitation during washing; of the recovery of part or all of each unit given, and of a determination of the "tonus" of the stomach (see page 309) and the proper functioning of the pyloric sphincter.

(b) *Astringing the Gastric Mucosa.* This is done by introducing 250 cc units of sterile warm water to which has been added 15 to 25 cc of the zinc chloride-formalin solution. This solution is withdrawn and the gastric mucosa is subsequently washed and rewashed until the returned water is again sparkling clear.

(c) *"Disinfection" of the Gastric Mucosa.* This is accomplished by washing the gastric mucosa with a 250 cc unit of freshly prepared silvol or potassium permanganate or mercurochrome in a solution of 1 to 5000. This is withdrawn and the stomach is again washed and rewashed with sterile water until the final 250 cc unit is sparkling clear and contains no visible flocculent particles.

It is to be remembered that the whole purpose of this attempt at cleansing and disinfecting the mouth, nasopharynx, esophagus and stomach is to get rid of annoying and disturbing elements leading to misinterpretation when the tube has reached the duodenum and is recovering materials from the duodeno-gall-tract.

Step 6. We now inject 4 oz. of sterile water through the tube in order to supply the stomach with a fluid to be emptied into the duodenum, and thus encourage gastric peristalsis to assist the tube into the duodenum. The proximal end of the tube is clamped off, the patient lies down on a bed or couch, turns well on the right side assuming the right Sims' position, and thereafter *very slowly* swallows the tube to the duodenal mark (75 cm. from the lips), taking at least twenty minutes by the watch to swallow this 20 cm. of additional tubing. It should be noted that this 4 oz. of sterile water is introduced *through* the tube and is not to be swallowed by the patient, thereby avoiding washing esophageal débris into the stomach. It is also of fundamental importance to impress upon the patient the necessity of *great care directed against consciously swallowing any saliva*. Patients should be provided with a clean enamel spitting dish or pus pan which they must use for this purpose. The total amount of saliva secreted and spat out during the examination is recorded and in many cases studied, for certain diagnostic inferences can be secured from attention to this detail (see page 239).

Step 7. Tests for position of tube.

(a) Test the material obtained by aspiration with dimethyl-aminoazobenzol. If no free HCl is present the tip is *probably* in the duodenum, except in cases of achylia gastrica when this test is of no value.

(b) Connect a 1-ounce syringe to tube and inject air in quick

spurts, and at the same time listen with a stethoscope placed over the *exposed* epigastrium. If the sound is heard over a considerable area with the point of maximum intensity to the left of the midline, and approximately as much water or air can be withdrawn as was injected, the tip of the tube is most probably in the stomach. If the sound is localized to the right hypochondrium, but no peristaltic bubbling or crepitant sounds are set in vibration, and no air can be withdrawn, the tip is probably in the grip of the antrum pylori, but has not passed through. If the sound is sharply localized in its maximum intensity to the right hypochondrium, and peristaltic crepitant sounds are set up by the injection of air, and only small fractions of air can be withdrawn, the tip is probably in the duodenum. This is the most reliable clinical test for the position of the duodenal tip. Fluoroscopic visualization comes first in accuracy, but all of us are not supplied with roentgen-ray aid in our office or hospital work, and it is well to develop clinical tests upon which we can rely. (For a discussion of other tests for position of tip see pages 313 to 315.)

If the tube has not entered the duodenum it must be pulled out as far as the stomach mark and again slowly reswallowed.

Step 8. Having determined the position of the tip to be in the duodenum a little air is injected to balloon out the duodenal walls and thus avoid trauma when *gentle* suction is exerted on the syringe. The duodenal fluid is lifted out and laid aside for study (see page 315). If bile stained material is obtained before stimulation with magnesium sulphate it is obvious that the common duct sphincter is open and part or all of the "A" or common duct bile has escaped, and cannot be differentially figured on.

Step 9. The gall-bladder is stimulated to evacuation of its fluid contents by instilling into the duodenum 75 cc of 33 per cent volumetric solution of magnesium sulphate at body temperature. This percentage is actually equivalent to a 16.66 per cent solution of magnesium sulphate. This solution is run in by gravity through the barrel of the syringe. The end of the tube is pinched to hold its syphonage and then attached to a drainage bottle. Suction by bulb or syringe is not applied unless fluid does not run out under gravity syphonage (under a pressure head of 18 to 24 inches), and then only by a 1-ounce bulb.

Step 10. When bile begins to flow past the "window" in the tube the collection bottle is changed and subsequent alterations in the gross appearance of the bile are followed by changing the collection bottle. The interpretation of the first bile obtained depends upon biliary regurgitation observed during Step 5 and the condition of Oddi's sphincter as determined under Step 8. If bile has been obtained at either of these two points the first bile

obtained after stimulation with magnesium sulphate is probably "C" bile.

Step 11. If the bile stops flowing or no "B" bile is obtained the patient is restimulated one or more times depending upon the amount of magnesium sulphate solution that has been retained. I make it a rule not to exceed at any one treatment 90 cc of the 33 per cent volumetric solution of magnesium sulphate being retained by the patient. This is equivalent to 1 ounce of a saturated solution of this salt, which is an average high dose when given by the mouth, and this dose should not be exceeded in the duodenum on account of its depressant action and its tendency to relax tonus of the entire intestinal tract, giving rise to an uncomfortable sense of distention and tympanites. My usual dosage is as follows: First stimulation 75 cc of 33 per cent solution and recover as much as possible; second stimulation 60 cc of 33 per cent solution; third stimulation 45 cc 33 per cent solution; fourth stimulation 30 cc 33 per cent solution, taking care as seen above that the total amount unrecovered and, thus retained by the patient, does not exceed 90 cc of the 33 per cent solution.

Step 12. Cultures are made as desired from any bile sample. For gall-bladder culturation the best material is afforded by the last of the "B" bile (the dregs from the floor of the gall-bladder). This is theoretically so, but is practically difficult of accomplishment. Cultures are taken directly into either glucose bouillon (Rockefeller formula) or Hormone broth (Huntoon formula) in special "fool-proof" flasks devised by Dr. Richardson. (For a special discussion of bacteriological technic see page 347.)

Step 13. Microscopy of Bile. The various specimens of bile should be examined microscopically within fifteen to thirty minutes after their withdrawal, special attention being directed toward their cellular elements, bacteria, mucus and crystals. (For special discussion of microscopy see pages 320 to 332.)

Step 14. When no further bile is being obtained or the drainage session is to be stopped, a fresh solution of silvol 1 to 5000 (using 10 cc of a 1 to 500 solution added to 90 cc of sterile water) is instilled into the duodenum and immediately withdrawn by syphonage. Amounts up to 75 per cent of this are usually obtained, but only rarely is the entire amount recovered. (The purpose of this duodenal disinfection is discussed on page 344.)

Step 15. The patient now sits up and is given a duodenal enema consisting of 250 cc of Ringer's solution at body temperature. This should be run in slowly by the drip method in not less than twenty minutes. This may be reinforced by adding from $\frac{1}{4}$ to 1 teaspoonful of the crystals of sodium sulphate as may be necessary to secure 2 to 4 fluid intestinal evacuations within three hours

following the drainage. The amount of sodium sulphate to be added to the Ringer's solution will depend upon the amount of the magnesium sulphate previously used and retained by the patient, and upon the average response of the individual patient to saline cathartics. (The purpose of the duodenal enema will be further discussed on page 344.)

Step 16. Withdrawal of the Tube. On completing the duodenal enema a little air is injected to free the metal tip by ballooning out the duodenal wall, and the tube gently but evenly withdrawn. Momentary obstruction may be encountered at the pylorus, at the cardia and at the glottis. At the first two points, or elsewhere except at the glottis, injecting a little air will release the obstruction. The retention of the tip of the tube at the glottis is promptly overcome by the patient swallowing simultaneously as the tip is withdrawn.

Step 17. The patient is given a pleasant mouth wash to rinse the mouth, and is then given a cup of beef broth and a few crackers. He is then permitted to go home and may often go about his business, but is encouraged to rest as quietly as possible. The total duration of this treatment averages two and a half to three hours. Where *liver* drainage is an essential in treatment the tube is left in and drainage continued for a longer period up to about six hours. (For a discussion of continual biliary drainage see page 459.)

CHAPTER XVIII.

DIAGNOSIS.—(CONTINUED.)

DETAILED DESCRIPTION OF THE TECHNIC FOR NON-SURGICAL DRAINAGE OF THE GALL-TRACT WITH DISCUSSION OF DIFFERENTIAL DIAGNOSIS.

THE best time to do a diagnostic drainage of the gall-tract is in the morning after the patient has had a twelve to fifteen hour fast. This takes cognizance of the fact that during the fasting or inter-digestive state of the stomach and duodenum it is *physiologically normal* to find the sphincter of the common duct guarding the entrance into the duodenum closed. The gall-tract is then also in a resting state and the ducts and gall-bladder are filled to a greater extent with bile than occurs during the active period of gastric and duodenal digestion. This fact more particularly holds true for the storage of gall-bladder bile.

The patients are instructed to present themselves at the office or the house resident is instructed to have his patient ready at the hospital at 8 to 9 A.M. on a twelve-hour fasting stomach following a motor meal which includes a meat sandwich (any kind of meat or fowl desired) and 6 stewed prunes or about 20 raisins or currants (see Fig. 62 Sec. 3). With this meal the patient may drink any simple beverage, but after its completion nothing further is to pass the lips until given by the doctor or nurse. On the morning of the examination the patient is not allowed to brush the teeth in order to avoid any trauma to congested or spongy gums which will produce bleeding or blood swallowing likely to interfere with the interpretation of the chemistry of the fasting gastric residuum. Likewise the patient should be particularly instructed to guard against swallowing any saliva that may form in his mouth or mucus that may be coughed up or brought down into the nasopharynx.

This is very important if we are to attempt to limit diagnostic confusion in the microscopical examination of the fasting gastric residuum.

The next step, which is taken to avoid as far as possible later bacteriological uncertainty, is to attempt to disinfect the mouth and nose as follows:

(a) The patient should thoroughly rinse and gargle the mouth and throat with a mild astringent solution. I prefer a solution

which contains zinc chloride and formalin. The following formula has been worked out for me by a chemist, Mr. Ambrose Hunsberger, who has called it "Zincloform," and is probably very similar to Lavisol, but the former can be made and sold by any competent druggist for considerably less than the trademarked commercial product.

SOL. ZINC CHLORIDE AND FORMALDEHYDE COMP.

R—Solution formaldehyde 40 per cent	24 minims
Menthol	48 gr.
Resorcin	32 gr.
Saccharine	12 gr.
Oil of cloves	24 minims
Oil of cassia	96 minims
Zinc chloride	126 gr.
Acid, boric	3iss
Purified talc	3ij
Cudbear	3j
Cochineal	3j
Alcohol	3v
Distilled water	1 gallon
M—sec. art.	

This solution can be used in a 1 to 2 dilution. The object of this is not only to cleanse the mouth, but to slightly astringe the buccal membranes and squeeze out from salivary ducts and tonsillar crypts and gingival margins desquamated epithelium, pus cells, bacteria and food débris. A microscopical examination of a slide preparation made from such centrifuged specimen, especially in a "dirty" mouth, will easily prove that it does do this.

(b) After this the mouth and throat are to be thoroughly rinsed and gargled with a 1 to 500 solution of potassium permanganate (approximately 1 gr. to the ounce). This amount of attempted disinfection appears to act better after the tubules and ducts of the buccal membrane have been partly unplugged of their contents.

(c) Following this the patient thoroughly rinses and gargles again with the astringent solution, and

(d) Finally repeats this procedure with sterile water.

(e) In cases who are subject to nasal catarrh, rhinitis or nasopharyngitis it is a good plan to spray and disinfect the nares as effectually as possible.

For a complete description of the apparatus to be used in a medical drainage of the gall-tract see Fig. 99. It is to be emphasized that every article contained in this set of apparatus shall be properly sterilized, and *particularly* each patient being handled should be provided with his own sterile syringe, and this and all other individual glassware should be used only in the handling of this one patient.

Having completed this step, a duodenal tube, freshly sterilized

by boiling and by steam, is swallowed and passed to the greater curvature represented by the first mark on the duodenal tube, which should be placed at 55 cm., and which in the average case closely approximates the distance between the lips and the greater curvature of the stomach. No water should be swallowed as the tube is being taken, as this will tend to carry contaminating material

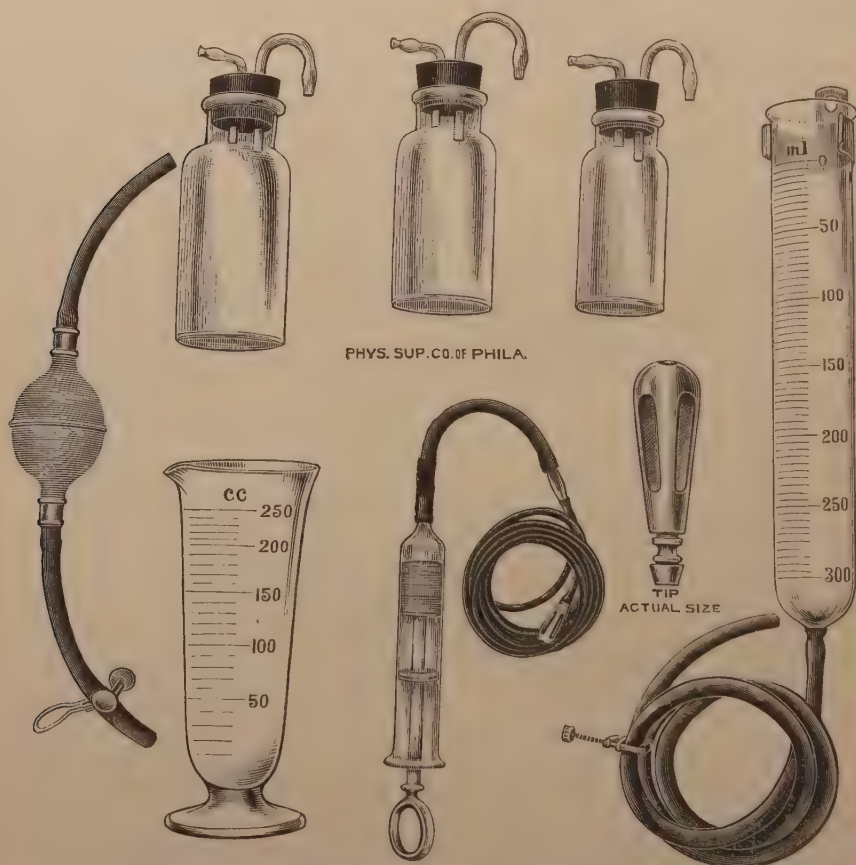


FIG. 99.—Illustrates the apparatus used in a medical drainage of the gall-tract. *Note:* The one ounce capacity suction bulb illustrated above is not to be used except in the exceptional case where drainage is very sluggish, nor is vacuum suction as advisable as drainage by simple gravity. This avoids trauma to the mucous membrane of duodenum.

into the stomach. All patients should be quietly reassured and patiently instructed to take deep, even breaths as the tube is being passed. There are many ways of successfully giving a duodenal tube with a minimum of discomfort. Well tube broken patients

will usually prefer to pass it themselves. For those who are unaccustomed in its use I find it good practice for the nurse or doctor to stand in front of the patient whose tongue is well extended, and with the forefinger, preferably gloved with a sterile finger cot, the metal tip of the tube is pressed down over the base of the tongue, and the patient instructed to swallow, at which point the finger is simultaneously withdrawn (see Fig. 100). As the tip passes the glottis and engages in the esophagus, a slight tug on the tube is



FIG. 100. —The method of passing the duodenal tube as recommended by the author.
First position.

felt, and the nurse or doctor then quickly steps behind the patient and feeds in the tube as the patient alternately swallows and opens his mouth to breathe (see Fig. 101). During this step it is well to note and record whether the tube was taken easily, without nervousness or coughing, or the development of a gag reflex or of esophageal obstruction, such as cardiospasm, inasmuch as these occurrences modify in certain directions the proper interpretation of the fasting gastric residuum (see page 257.) After a patient becomes "tube

broken" as a general rule they will prefer to swallow the tube without assistance from either nurse or doctor, as illustrated in Fig. 102.

In patients in whom one wishes to check up a previous diagnostic study chiefly for the more accurate determination of the *bacteriology* of the duodenum and gall-tract, I find it advisable before passing the sterile tube to attempt the "disinfection" of the esophagus by having the patient swallow 100 cc of a 1 to 5000 solution of potassium permanganate or of freshly prepared silvol, which washes down the

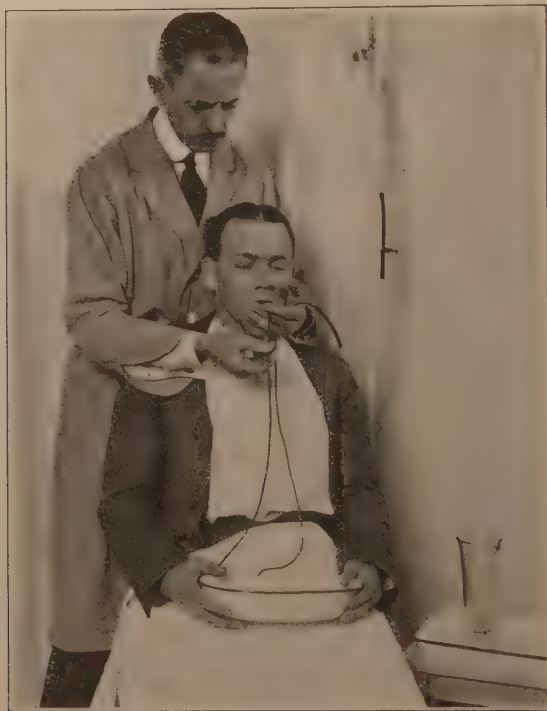


FIG. 101.—The method of passing the duodenal tube as recommended by the author. Second position.

esophagus, and after this pass the duodenal tube and drain out or aspirate by syringe as much of this solution as possible before proceeding to wash the stomach. Having made use of this step it is obviously impossible to make any accurate study of the chemistry of the fasting gastric juice.

The fasting gastric residuum is now extracted by gravity or by syringe aspiration into a conical graduated glass vessel, and notes should be carefully recorded of its amount, its color and its gross consistency and characteristics. In addition to the total amount

the relative proportion of the sediment to the supernatant fluid contents should be independently recorded. The sediment is then examined microscopically in fresh preparation, stained and unstained, and the filtrate is tested for free and total acids, and both filtrate and sediment tested for the presence of occult blood with guaiac and benzidene. (For a more elaborate discussion of the study of the fasting gastric residuum see page 256.)



FIG. 102.—Illustrates duodenal tube swallowing by a well “tube broken” patient.

The stomach is now thoroughly washed, astringed and disinfected. (See Fig. 103.)

1. Washing the Gastric Mucosa.—This is done by repeated douching and withdrawal of 250 cc units of sterile water introduced at body temperature from the graduated 250 cc cylinder placed about 18 inches above the patient's head, and continued until the wash

water is sparkling clear. Attention is paid to and notes recorded of the number of 250 cc units required to clean the gastric mucosa of its surface slime; of the amount and general gross characteristics of the mucus floccules recovered; of the occurrence of biliary regurgitation during this lavage; of the recovery of part or all of each unit given; of a determination of the tonus of the stomach; and the proper functioning of the pyloric sphincter. (See Fig. 61, page 210.)



FIG. 103.—Represents the method of gastric lavage as recommended by the author, which is of use in topically treating the gastric mucosa in the overnight fasting state. Where there is gross retention much time may be saved if the stomach is washed by means of an average size stomach tube instead of the duodenal tube, and using 500 cc units instead of 250 cc.

B. Astringing the Gastric Mucosa.—This is done by introducing a 250 cc unit of sterile warm water to which has been added 25 cc of the zinc chloride formalin solution. This solution is withdrawn and the gastric mucosa is subsequently washed and rewashed until the returned water is again sparkling clear. The effect of this astringent is to compress (literally to shrink) the gastric mucosa and by so doing press out from the tubular ducts floccules which are to be microscopically examined (see page 240), and which furnish our best diagnostic inferences of a true gastritis (see page 260).

C. **"Disinfection" of the Gastric Mucosa.**—I attempt to accomplish this by washing the gastric mucosa with a 250 cc unit of freshly prepared silvol, silver nitrate, potassium permanganate or mercurochrome in a solution of 1 to 5000. As a rule, I prefer the first mentioned agent. This is withdrawn and the stomach is again washed and rewashed with sterile water until the final 250 cc unit is sparkling clear and contains no visible flocculent particles. I believe that this is the appropriate time to attempt "disinfection" of the gastric mucosa, inasmuch as the preceding use of the astringent has unplugged the secreting tubules of their mucus floccules, and thus permits the disinfecting solution to more effectively permeate the gastric mucosa. That this is, from a strict bacteriological standpoint, effective in all cases is very much to be doubted, nevertheless we have repeatedly demonstrated our ability to recover positive cultures from the stomach *before* the use of the disinfectant, whereas the cultures made *after* its use have been either sterile or show a distinctly lessened number of colonies developing in quantitatively planted Petri plates.

It is to be remembered that the whole purpose of this attempt to cleanse and disinfect the mouth, nasopharynx, esophagus and stomach is to get rid of annoying and disturbing elements which lead to misinterpretation when the tube has reached the duodenum and is recovering materials from the duodeno-gall-tract.

For a number of years I have adopted a 250 cc unit for lavage with the duodenal tube and a 500 cc unit for lavage with the large stomach tube. The first purpose for this lies in the fact that we are introducing standard amounts which are again recovered in a conical graduate, so that if interesting looking floccules or bits of food or tissue remnants, which should be microscopically examined for cytology, are recovered, they can be easily recognized and pipetted from the graduate without the danger of their being lost or escaping notice if the outflow is recovered in a large pail or other vessel. The second purpose is that by using such small volumetric units, which are successively recovered, we avoid any danger of overdistending a stomach with a weakened wall, and thus remove one of the contraindications for gastric lavage, namely, atony of the stomach, which is so consistently mentioned in most standard monographs on the treatment of the stomach. I believe that lavage when practised in this way is not harmful to the stomach, but, on the contrary, is exceedingly beneficial. It is easy to understand how atony was made a contraindication for lavage of the stomach if one recalls the older methods and illustrations of practising it (Figs. 104 and 105). In those days, having passed a large stomach tube with an attached funnel, the doctor or nurse stood at the head of the patient and with a large 2-quart pitcher kept pouring

unknown quantities of water into the stomach, usually in such large amounts that the water would be regurgitated back through the



FIG. 104.—Lavage through the nostril: First step. (Kemp.)



FIG. 105.—Lavage through the nostril: Second step. (Kemp.)

mouth and nares of the patient, and in the illustrations each arm and leg of the struggling patient will be seen to be held by an individual nurse or orderly. Such practice is, of course, preëminently bad.

Other data of diagnostic inference which can be acquired by the use of this method of 250 cc units is concerned with a clinical method of estimating the *tonus* of the stomach by timing the rate of inflow and outflow of several successive units and striking an average. I find that in states of *normal tonus* it requires approximately one and a half minutes for inflow through the ordinary calibered duodenal tube, and about one and three-quarter to two minutes for outflow, and the flow of water both in and out is even and steady. In states of *hypertonicity* a less time is usually required in both in- and outflow, and in the latter the water may be expelled in a sudden rushing stream, or by distinct spurtings. The latter is more often seen in states of hypertonus with *spasm*, and in such cases the inflow, instead of being rapid and even, will flow in steadily for a few seconds and then the column of water will be seen to oscillate for a second or two as an intragastric spasm takes place before resuming its flow. In states of *hypotonus* both the inflow and outflow time is increased to two minutes or longer and in the outflow the water is recovered in a very slow trickling stream, which at times may cease entirely, and fresh recovery must be induced by syringe aspiration.

Secondly, by this method we can gain certain inferences as to the proper *functioning of the pyloric sphincter* in our success or failure to recover all of the 250 cc unit introduced. In patients with normal gastric tonus the introduction of the first one or two units, practically all of which can be recovered, will set up an increased rate of gastric peristalsis so that in subsequent returns our recovered amounts are 25 to 50 cc short, indicating that the difference has been forced through a properly functioning pylorus. In hypertonus cases without spasm the recovered amounts may be considerably less, but in states of spasm involving the pylorus the reverse may be found. In cases in which we find loss of pyloric sphincter action, as in achylia with its rapid motility, we may find our amounts recovered are short to the extent of 100 cc or more.

Thirdly, by this method we gain an impression of reverse peristalsis in the duodenum which is so frequently found in association with duodenal irritation sufficient to cause dysfunction of the common duct sphincter, and we will notice in such cases that bile is being regurgitated into the stomach and is coloring our clear wash water a light yellow, and bringing back from the duodenum bile stained floccules.

All of these *little* points when analyzed will tend to modify or

strengthen our total diagnostic impression of this step in diagnosis. All of these details can be made a matter of easy record if one follows the scheme outlined on the biliary drainage sheet (see page 210).

In regard to the item of "total glasses clean," which refers to the total number of 250 cc units used in washing, astringing and disinfecting the stomach, and finally bringing the last wash-water to a state of crystal clearness, I find that in the normal stomach an average of 7 units is sufficient, whereas in a "dirty" stomach, due to catarrh or infection either in the stomach or duodenum, the total



FIG. 106.—Illustrates the technic recommended by the author for rapid intubation of the duodenum. (See text, page 311).

number of units may reach 15 or 20, and in certain cases with marked catarrhal exfoliation we never are able to bring the final wash-water back to crystal clearness.

We now inject 4 ounces of sterile water *through* the tube in order to supply the stomach with a fluid menstruum and thus encourage gastric peristalsis to assist the tube into the duodenum. The proximal end of the tube is now clamped off, the patient lies down on a bed or a couch and turns well on the right side, assuming the right Sims' position, and thereafter *very slowly* swallows the tube to the duodenal mark, (which is placed at 75 cm. from the lips),

taking at least twenty minutes *by the watch* to swallow this 20 cm. of additional tubing (see Fig. 106). It should be noted that this 4 ounces of sterile water is introduced *through* the tube and is not to be swallowed by the patient, thereby avoiding washing esophageal débris into the stomach. It is also fundamentally important to impress upon the patient the necessity of *great care directed against consciously swallowing any saliva*. Patients should be provided with a clean enamel spitting dish or pus pan which they must use for this purpose. The total amount of saliva secreted and spat out during the examination is recorded and in many cases should be studied, for certain diagnostic inferences can be secured from attention to this detail.

DIFFERENTIAL DIAGNOSIS.

Having properly prepared the stomach according to the above procedures we are now in a position to attempt to enter the duodenum. With the type of duodenal tip which we are now using (2) (see Fig. 99) this transit time of tube from stomach to a point in the duodenum at the level of the entrance of the common bile duct should be accomplished on the average in *twenty minutes*. Successful duodenal intubation in certain cases can be made in less than twenty minutes, and in no uncomplicated cases, providing a proper technic be employed, should it take longer than thirty minutes. The great secret of rapid entrance into the duodenum lies in a *slow swallowing* of the 20 cm. of tubing (from the 55 cm. point to the 75 cm. point), after having introduced 120 cc of sterile water *through* the tube at the conclusion of the cleansing and disinfecting gastric lavage to give the stomach some fluid menstruum upon which to exert its peristaltic action. This takes cognizance of the fact that the pylorus normally opens and closes from 6 to 15 times a minute. If 1 cm. of tubing is swallowed every minute this means that when the tip of the tube impinges on the pyloric opening it will have at least six chances of engaging in the pylorus during that minute. Whereas if the tube is swallowed too fast the tip impinges on the pylorus when it is closed and another swallow carries it across the gastric side of the pylorus and buckles it up and backward into the stomach as represented in Fig. 107. Very occasionally the tube will tie itself into a knot. This happened in only two patients in 600 consecutive intubations, but in those two patients did this several times. They both had excessive hyperperistalsis. In uncomplicated cases the patient should be lying on the right side in somewhat the Sims' position during the period of passing the tube from stomach to duodenum. In certain cases in which we encounter difficulty in duodenal entrance due to mechan-

ical factors, such as distortion of the pyloro-duodenal canal by adhesions, or by downward traction in visceroptosis, or by pressure from neighborhood new growth, it is often necessary to attempt many postural changes, such as elevating the hips, turning on the abdomen, or occasionally to the back or left side, and quite frequently allowing the patient to get up and walk about for a few moments. In one of our most difficult recent cases we have met with success by using a contrivance suggested by the patient, a mechanical engineer, of attaching a small caliber copper wire, perforated sinker, weighing about 75 gm., into which is tied a 2-inch

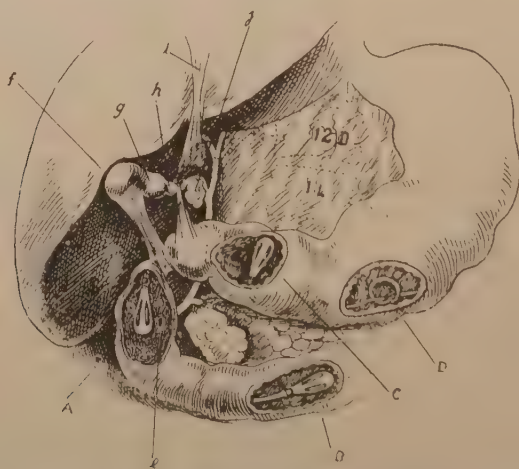


FIG. 107.—Illustrates certain difficulties to be overcome in properly intubating the duodenum for biliary-tract drainage, and some of the reasons which will explain the inability to recover gall-bladder bile ("B" fraction) from certain cases. *a*, duodenal tip properly placed opposite ampulla of Vater; *b*, improperly placed; *c*, tip failed to impinge in pylorus (too rapid swallowing); *d*, tube knotted; *e*, ampulla of Vater; *f*, gall-bladder with adhesions to duodenum; *g*, gall-stone in neck of gall-bladder; *h*, gall-stone in cystic duct with adhesions to duodenum; *i*, suspensory ligament of liver; *j*, enlarged lymphatic gland obstructing cystic duct.

piece of fish line and tied at the other end to the tip of our duodenal tube. This provides the extra weight recommended by Palefski. This proved successful in this patient's individual case to an extent that warrants further experimentation with this device. In certain cases of duodenal adhesions constricting the lumen, the smaller calibered sinker will pass the constriction, and by its weight acting on a flexible cord (the fish line) will pull the larger duodenal tip through after the manner of a filiform catheter passing a urethral stricture.

Aside from organic pyloric obstructive difficulties, such as stenosis

from new growth, or inflammatory edema, in addition to what has been said above, we frequently encounter a physiological obstruction due to pylorospasm. 'This may be ruled out by repeating the duodenal intubation after a few days' use of tincture of belladonna to physiological effect, or one or more injections of atropine sulphate given just prior to an attempted duodenal intubation. If this is not successful our difficulty in duodenal entrance is probably not due to spasm alone.

Our next question is to determine *whether* and *when* we have reached the duodenum. No attempt is made to decide this until after a transit time of twenty minutes has elapsed. The first procedure then should be to release the clamp on the tube and see whether bile will drain out. If it does, it indicates one of two things, both of which are of diagnostic importance. Either the tip is in the duodenum, and we thereby prove by the return of bile that the sphincter of the common bile duct is open and discharging bile into the duodenum in the interdigestive gastric and duodenal phase, which I believe to be indicative of a disturbed physiological function of Oddi's sphincter (except in cholecystectomized or in certain otherwise operated cases), or that the tip of the tube is still in the stomach and we are recovering bile from duodenal regurgitation through the pylorus. This, too, is equally suggestive of disturbed physiology. But this possibility should previously have been made evident by the recovery of gross biliary regurgitation in the fasting gastric residuum or by duodeno-biliary reflux occurring during the period of gastric lavage.

Assuming, however, that *no* bile drains out from our unclamped tube, how are we then to tell the position of our tip? The so-called "duodenal tug," or traction tug, determined by gently attempting to withdraw the tube at the mouth, and assumed to be due to pyloric pressure, I have found unreliable, since it can be simulated by a cardio- or esophageal spasm, or by pressure from the glottis, or simply by a tube pressed against the roof of the mouth by a large beefy tongue or hooked around a molar tooth.

I have found the following procedure to be by far the most reliable. Before attempting to pass the tube from the greater curvature to the duodenum I stethoscope the abdomen as the sterile water followed by a 1-ounce syringe full of air is being injected into the stomach. The maximum auscultatory bubbling sound, due to the blowing of air through water, indicates the approximate position of the tip of the tube, and in the normal anatomical subject, with the patient lying on his back, this point is invariably found to be in the left epigastrium 1 to $1\frac{1}{2}$ inches above and to the left of the navel. When the tip of the tube is actually in the duodenum the maximum air sound is heard at the duodenal point, 1 to $1\frac{1}{2}$

inches above and to the right of the navel, and is followed by a shower of very fine, but often sticky, crackling rales, due, I think, to a separation of the sticky mucosal surfaces as the duodenal walls are ballooned apart by the air blown in, followed by an excitation of duodenal peristalsis.

To make more sure, however, two other procedures may be carried through: (1) To test the acidity of the fluid recovered by syringe withdrawal, and compare it with the acidity already determined in the fasting gastric residuum. As a general rule it is either negative

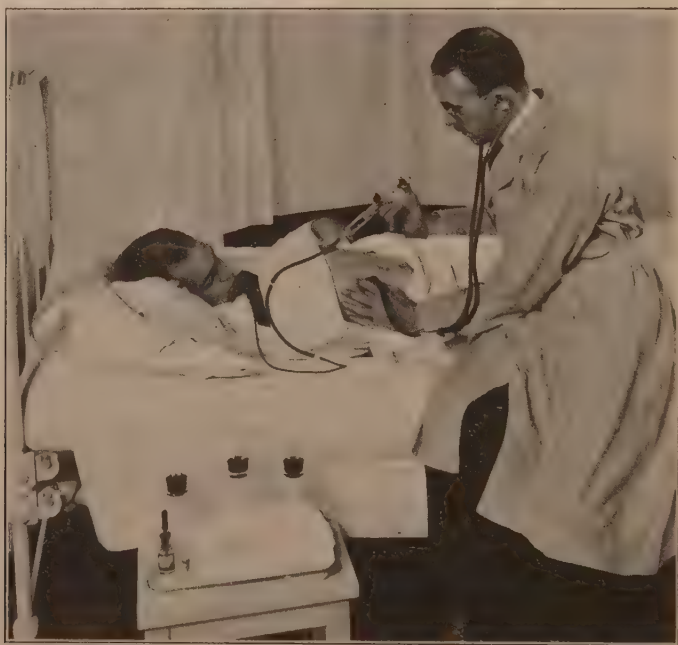


FIG. 108.—Illustrates the clinical method of locating the tip of the duodenal tube which is recommended by the author as the best and most accurate of the several clinical tests mentioned in the text.

for free HCl or appreciably less when the tip is in the duodenum although occasionally a spurt of freshly secreted gastric juice may have passed through the pylorus and entered the duodenum synchronously with its withdrawal rendering it slightly positive for free HCl. (2) We also gain some diagnostic help by the ease with which the aspirating plunger of the 1-ounce syringe can be wholly or partially withdrawn *without* suction collapse of the rubber tube. When our tube is in the duodenum very much less air suction can be made than with the tip in the stomach. But to rule out con-

fusion from either of these two points we occasionally have the patient drink a third of a glassful of sterile water and attempt to immediately aspirate this by the syringe. If the tip is still in the stomach we can promptly withdraw the larger amount of this water, but if it is in the duodenum we get practically a dry tap.

Of course, the most accurate and least time consuming method of determining the position of the duodenal tip is by means of fluoroscopic visualization, but inasmuch as this refinement in diagnostic aid is not always available it has become necessary to develop other equally satisfactory means. It is now possible to say that by the methods outlined above we have no difficulty in determining definitely whether or not the tube is in the duodenum, and I can repeat the statement made earlier that day in and day out in the uncomplicated state of anatomy or physiology we should reach the duodenum in twenty minutes, and not require the longer periods so commonly mentioned by other writers. In cases complicated by adhesions or by organic obstructions the duodenal transit time may be delayed, but by increasing the weight of the tip we can in certain cases help to overcome this difficulty, although this does not facilitate tube passage in cases of pylorospasm.

Differentially, thus far then we have formed certain diagnostic impressions regarding organic or physiological complications of tube transit and physiological dysfunction of Oddi's sphincter with or without duodenal irritation producing reverse peristalsis.

Having definitely reached the duodenum, our next diagnostic procedure is to withdraw as much duodenal contents as possible and note its color and gross characteristics, such as increased viscosity, mucoid flocculation (indicative of either simple catarrhal or exfoliative duodenitis), and set it aside for prompt titration of its chemistry, determination of occult blood and pancreatic enzymes, and preparation of unstained cover slip spreads for microscopical cytology.

Normal duodenal juice or fluid, when recovered from the fasting duodenum, is generally a gray, translucent, and distinctly mucoid fluid, but unless the duodenum is the seat of catarrh, it does not contain the sticky, string-like strands of mucus, which, by some authorities, are considered normal. The amount of fasting duodenal juice is small, rarely over 20 cc., and often 10 or less. In contrast to the gastric juice, which, with the exception of its relatively increased viscosity, it closely resembles, it is alkaline in its reaction to litmus paper and when titrated to decinormal hydrochloric acid. Occasionally duodenal juice will be recovered and found to contain free hydrochloric acid, this being due, of course, to the fact that a collection is made just after a spurt of gastric juice has entered the duodenum and before it has become neutralized by the duodenal secretions.

Occasionally, too, the duodenal juice will be bile tinged in the twelve-hour fasting stage, and under these circumstances is in an impure state. I personally believe, although others differ on this point, that unless the tube has been taken badly, producing a noticeable gag reflex, resulting in diaphragmatic contraction, that the finding of gross bile in the fasting duodenum is suggestive of physiological dysfunction of Oddi's sphincter, either compensatory or pathological (gastric or duodenal ulcer, duodenitis, gall-tract disease and certain forms of chronic appendicitis, usually with upper right quadrant adhesions).

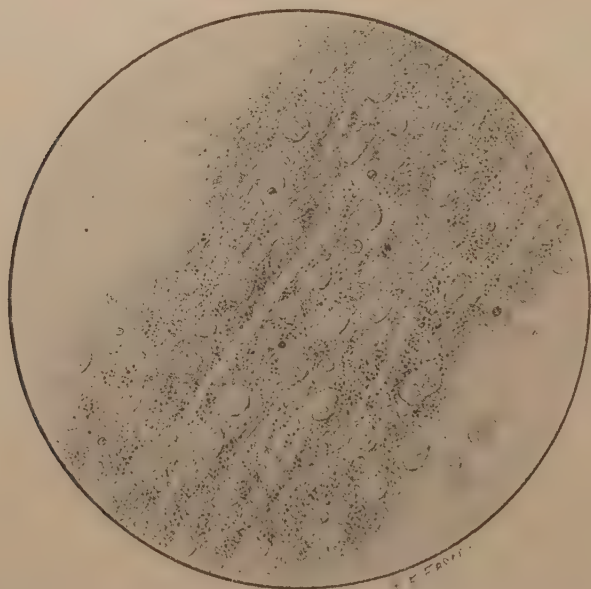


FIG. 109.—Band of duodenal mucosal epithelium in first stage of degeneration with multiple vacuoles and inclusion bodies and tendency of cell membrane to rupture, depositing granular debris. $\times 385$.

The *cytology* of the uncentrifuged normal duodenal fluid will microscopically show only occasional unbile stained, pearly gray oval or cuboidal epithelial cells, never more than twenty or thirty to the low power field, together with small flakes of mucus, not intimately associated with the exfoliated duodenal cells, only an occasional white blood corpuscle and a scattering of bacteria in process of transit and not occurring in masses, clumps or colonies.

This normal microscopical cytology is in striking contrast to that which occurs in duodenitis or other pathological states of the duodenum in which will often be found enormous masses of exfoli-

ated duodenal cells in various states of degeneration, often several hundred to the field and quite frequently peeling off in a sheet-like manner, and attached to a ribbon-like band of mucus. (See Fig. 109.) Associated with this will be found microscopical evidence of inflammation in an out-pouring of white blood cells, a proliferated bacterial flora, and in acute duodenitis or active duodenal ulcer, numerous blood corpuscles.

All duodenal glassware should be labelled "D."

The duodenum is then gently douched with 75 cc of magnesium sulphate by gravity instillation through the barrel of the 1- or 2-ounce syringe, and immediately withdrawn by syphonage, and the proximal end of the tube connected with the first sterile drainage bottle labelled "A." If it has been already proven that bile has escaped from the common duct, through an unphysiological sphincter into the duodenum, we obviously cannot carry out a segregation of the usual three types of bile, and the tube is then attached to the sterile bottle labelled "BC," indicating that our first bile recovered is a mixture of gall-bladder and liver biles, both being expelled from the common duct.

With exceptions to be mentioned later, in all normal and in certain pathological gall-tract cases the drainage sequence is very much of the same type, and is usually as follows: Shortly after the magnesium sulphate solution reaches the fasting duodenum there occurs a relaxation of tonicity in the duodenal wall (as first shown by Meltzer, and since confirmed by other experimental laboratory workers), and within a few seconds to three minutes the normally closed ampullic sphincter described by Oddi, likewise relaxes, and within approximately this same period bile begins to tinge the magnesium sulphate solution which is being recovered by gravity syphonage from the tube. When this bile tinged magnesium sulphate solution has been withdrawn, and is being replaced by a light golden-yellow bile, the tube is connected with the first sterile drainage bottle labelled "A." This "A" bile, since it is the first obtainable from the closed sphincter, must be bile lying within the common duct, and later becomes slightly diluted with bile from the cystic and hepatic ducts, with perhaps a few drops of gall-bladder bile. (See Fig. 110.)

Drainage is then continued until the bile deepens to a darker shade of golden-yellow to yellow-brown with a viscosity between that of syrup and a thin molasses. This is a mixture of the first portion of gall-bladder bile mixed with the last of the common duct bile, and still further diluted with liver bile. At this point the tube is disconnected from the sterile bottle labelled "A" and attached to a sterile bottle labelled "B," and the drainage continued. The color gradually deepens and the fluid becomes more

viscid as the purer gall-bladder bile is being discharged, although it must be understood that this too is being constantly thinned out slightly by admixture with liver bile.

With a gall-bladder possessing a normal muscular wall, and under normal tension, this type of bile averages from 1 to $2\frac{1}{2}$ ounces, and is discharged under one magnesium sulphate stimulation in from ten to fifteen minutes, when it is gradually, although sometimes quite abruptly, replaced by a very much lighter and thinner lemon to straw-colored bile than either of the first two types. This I call

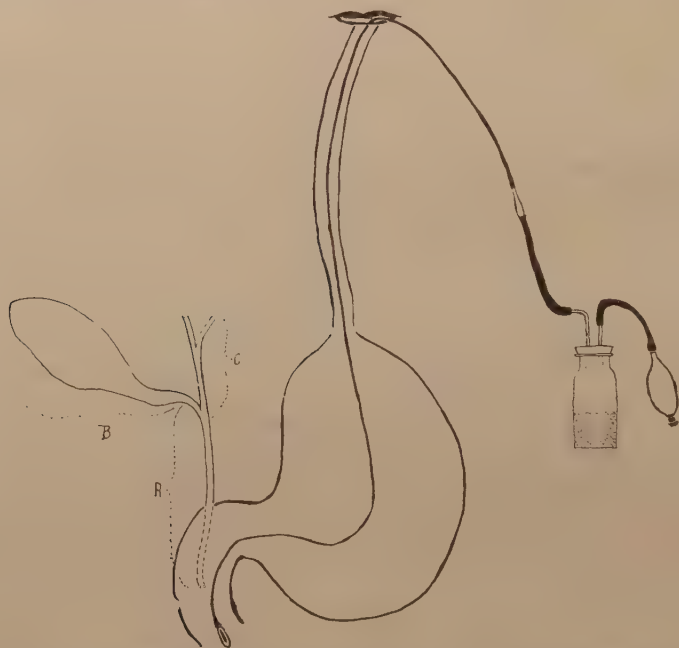


FIG. 110.—This drawing illustrates the method of non-surgical biliary drainage, part of the apparatus used and the sources from which the various types of bile are obtained. A set of three or more sterile bottles is used for each segregation of bile for diagnosis.

“C” bile and believe to be freshly secreted and expelled liver bile. When this transition takes place a connection is made with a third sterile bottle labelled “C” and the drainage continued over as long a period as we may desire.

The amount of “A” or duct bile averages from 5 to not more than 30 cc and is discharged rather rapidly within approximately five minutes. The “C” bile from the liver may continue to drain for a long time, even up to several hours, and several ounces may be secured if drainage is continued over a two or three-hour period.

PLATE VI

FIG. 1

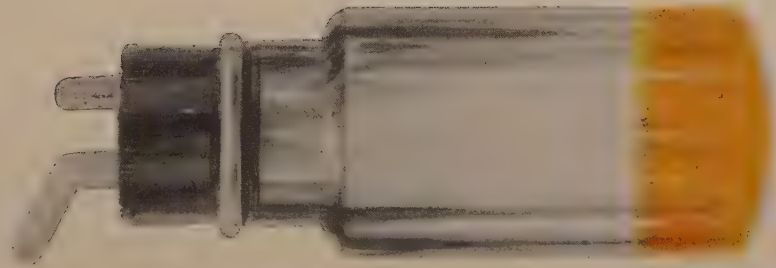


Fig. 1. Common duct bile (chiefly).

FIG. 2



Normal A, B and C Fractions of Bile.

Fig. 2. Gall-bladder bile (chiefly).
See Fig. 110.

FIG. 3

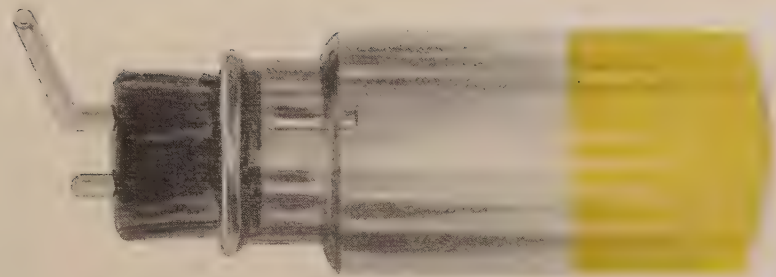


Fig. 3. Liver bile (pure).

There are many interesting phenomena concerned in the method of delivery of these several biles. They may vary in the manner of return and the velocity of their discharge, whether it be by intermittent drops, sudden spurts, or a steady, even flow.

Olive oil will be found a very useful agent to secure the "B" or gall-bladder fraction. It certainly stands next to magnesium sulphate in possessing some selective harmonic interaction with the gall-bladder, stimulating it to discharge its contents. Dr. J. B. Luckie, of Pasadena, California, was the first person to bring this to my attention. Its use as a biliary evacuant is of long standing. Earlier investigators had found that if olive oil was introduced into the stomach it was very apt to produce reversed peristalsis in the duodenum and cause duodenal-biliary reflux into the stomach. This was the only means then available to secure duodeno-biliary tract fluid for examination until after the first duodenal tube was devised about a quarter of a century ago. It is probably because the bile possesses the power to aid in the splitting and absorption of fats that this delivery of *concentrated* gall-bladder bile occurs after an olive oil stimulation.

In the order of effectiveness as gall-bladder evacuating stimulants I would place magnesium sulphate first, olive oil second, and solutions of peptone (10 per cent) third. In certain instances, however, olive oil has succeeded where magnesium sulphate has failed. My custom is to try magnesium sulphate first. If it fails to secure the "B" fraction or produces much post drainage pain or too great laxation, I then try olive oil.

My procedure is to introduce 1 ounce of a pure olive oil, warmed to body temperature, into the duodenum through the tube, clamp off the tube for ten minutes, and then, releasing the clamp, secure drainage by gravity. If a culture is to be made from the "B" fraction the olive oil must be sterilized, otherwise this is not necessary.

The use of olive oil instead of magnesium sulphate is of value if specific gravity estimations of the bile are desired, for the oil floats on top and can be readily pipetted off, leaving the pure bile unaltered as regards its specific gravity. Magnesium sulphate, on the other hand, whether absorbed by the liver or not, cannot be easily separated from the bile, and so raises the specific gravity as to make such estimations inaccurate and therefore useless. (See page 130.)

In all normal gall-tracts all three of these different colored bile fractions should be perfectly clear and transparent and contain no microscopical cytology in the uncentrifuged specimen. In certain pathological cases in the earlier stages and of lesser severity, the gross colors of these biles may be identical with those of the normal, but there may be an increased sliminess or increased viscosity due

to partly dissolved mucus which may adhere to the glass observation window, and, in addition, there will be a small but appreciable amount of flocculent particles which can be readily picked out of the uncentrifuged specimen with a 1 cc pipette and which microscopically present certain cytological features to be described later.

In both the normal and this type of earlier pathological case it will be noticed in many instances that certain portions of the bile recovered undergo a sudden turbidity which colors them to an appearance like that of mustard, with occasionally a smoky hue. This I have found is due to a spurt of acid gastric juice passing from the stomach into the duodenum and mixing with the clear bile. (See page 115.) This naturally happens more frequently with a hyperacid gastric state of secretion, and when occurring in pathological cases is in favor of cholecystitis or choledochitis, rather than of cholelithiasis. Occasionally, too, it will be seen that this turbidity takes on a light green color which is due to a rapid oxidation of some element in the bile, possibly biliverdin. The first type of turbidity above described can be invariably produced artificially in all clear, transparent biles by the addition of a few drops of dilute hydrochloric acid, and the depth of this turbid emulsion is in direct proportion to the strength of the hydrochloric acid which is added. When this turbidity, so produced, is accompanied by effervescence I believe it has some diagnostic significance in favor of gall-stones or of a precalculus forming chemistry in the bile, presumably a calcium or sodium carbonate, since the effervescence shows a striking similarity to that produced in dissolving a cloud in the boiled urine on the addition of a dilute acid.

In certain pathological cases the gross appearance of the biles may be very close to the normals except for an increased sliminess and evidence of catarrh in the shape of mucopus flocculations. The microscopical cytology of these flocculi, together with the positive bacteriological evidence in fresh spreads, later checked up by cultural growth, is the only clinical method that offers any possibility of definitely diagnosing the *early* gall-tract lesion.

Let us consider the possibilities of aiding diagnosis by a study of the *microscopical cytology*. In *normal* cases we can always find, in the *centrifuged* specimen, a few desquamated epithelial cells, an occasional leukocyte, an occasional strand of mucus, less frequently an occasional crystal, and we can usually demonstrate the presence of a few bacteria. Therefore, a first criterion as regards biliary tract health or disease is furnished by the gross observation of the *amount* of floccules which cover the bottom of the bottle and which can be picked out by pipette from *uncentrifuged* specimens.

Quantitative expression of the flocculi in regard to diagnosis is

therefore very important. Beyond the very occasional floccule which occurs in normal cases, the presence of large numbers of them is indicative of catarrh. Where the flocculi cover from $\frac{1}{8}$ to $\frac{1}{4}$ of the bottom of the bottle and microscopically show only mucus strands with pus cells and exfoliated epithelial cells, I take this to indicate a relatively mild catarrh and score it plus 1; where $\frac{1}{2}$ of the bottom of the bottle is covered by flocculi I consider the patient has a moderately severe catarrh and score it plus 2. Where the catarrhal or inflammatory state is a severe one the flocculi and mucus slime will cover $\frac{3}{4}$ or all of the bottom of the bottle and this is scored plus 3 or 4. Whether this catarrhal inflammation is duodenal or gall-tract or a combination of the two is differentiated by whether the mucus flocculi are or are not bile stained and by a microscopical study of the individual cells, differentiating the columnar from the cuboidal or oval. As a general rule the latter are to be interpreted as being derived from the duodenum. These flocculi may appear as fine and feathery, or as thick clumps or granular or shaggy masses. Sometimes where the viscosity or mucosity of the duodenal fluid or the bile may be so great that the mucoid flocculi cannot sink down to the bottom of the bottle, they will remain suspended or festooned down at various levels. (See Plates VIII, page 328.)

In each examination note should be made of the bottles from which flocculi are being withdrawn for examination. From the duodenal bottle, labelled "D," in states of *duodenitis* we can differentiate three types, a simple catarrh, an exfoliative catarrh, and to either of these may be added microscopical evidence of infection. In *simple catarrh* the microscopical picture consists largely of strands of mucus with an occasional cuboidal or oval epithelial cell, with a moderate to large increase in leukocytes, and the presence of bacteria rather diffusely scattered throughout all fields. In *exfoliative catarrh* we have the above cytological picture, but larger numbers of desquamated epithelial cells, oval or cuboidal, of the duodenal type, which in the more extreme cases will be peeled off in large sheet-like masses containing enormous numbers of these epithelial cells.

Practically all histologies state that the whole of the small intestine is lined by columnar or cylindrical epithelium. However, from routine microscopical examination of *fresh* duodenal and biliary tract extractions and a study of the cytology, I have been impressed by the uniform frequency of recovery of oval or cuboidal epithelial cells from the duodenum rather than columnar or cylindrical cells, and believe they are to be interpreted as derivable from the duodenum. (See Fig. 109, page 316.) The cells are slightly larger than a leukocyte and are a pearly gray-white in the fresh state, except

where malfunction of Oddi's sphincter permits of the continuous ejection of bile into the duodenum when the cells absorb the bile and are tinted a light to deep yellow. They are positively not columnar epithelial cells in the fresh state. Occasionally one sees columnar unbilestained epithelial cells recovered from the duodenal zone, but close examination shows them to be derivable from the stomach and simply washed into the duodenum by the gastric juice.

Not infrequently exfoliated cuboidal epithelial tubular gland structures can be made out, preserving the architecture of the normal tubule when observed longitudinally, and when seen in cross sections appearing in a rosette-like form.* As a rule the epithelial cells are more or less degenerated, even when exfoliated in large masses and clusters. Many of them contain large vacuoles and inclusion bodies, and the cytoplasm is very finely granular. The mucus strands and pus cells seen in the simple catarrhal form also appear in this type and are often in greater abundance.

In the *infected forms* of duodenitis it will be found in addition that the bacteria, although still seen diffusely scattered throughout all fields, are beginning to clump together in masses in close contact with strands of mucus or desquamated epithelium, and here and there one finds that the bacteria have gone into definite *colony* formation. These colonies have the same microscopical appearance when seen under a low power magnification as seen on the surface of a Petri culture plate when observed by the low power ocular, being much denser in the center and thinning out to the periphery with clean or irregular edges, where the morphology of the individual bacteria can frequently be made out. When I find evidence of *colony* formation I feel it right to assume that these bacteria are not simply in process of transit through the intestinal tubing, but have found a suitable feeding and breeding ground with a *locus minoris resistentiæ* upon which they can thrive. (See Figs. 111 and 112.)

In all three of these types an essential point to determine is whether or not the epithelial cells, pus cells and bacteria are or are not *bile stained*. If they are not bile stained we can assume that the sphincter of the common bile duct is properly functioning and that bile is being ejaculated at intermittent intervals only. This point is then rechecked by a review of the previous findings which should demonstrate an absence of fasting stomach biliary regurgitation and a closed ampullic sphincter prior to magnesium sulphate stimulation.

On the contrary, when these duodenal elements are found heavily bile stained one must argue that there is disturbed physiology

* See Report of Case XL.



FIG. 111.—Photomicrograph of bacterial colony from duodenum. $\times 110$.

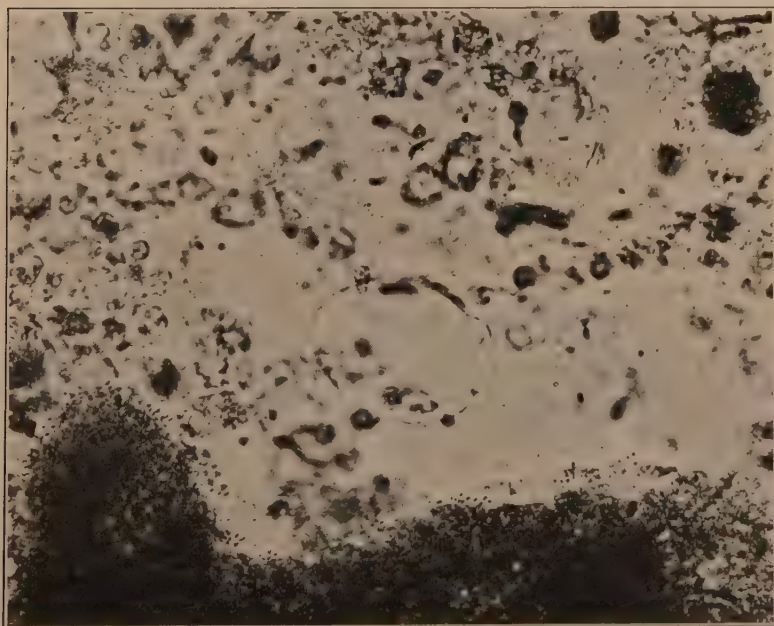


FIG. 112.—Higher magnification of Fig. 111. $\times 385$.

involving Oddi's sphincter which permits of a continuous ejaculation of bile into the duodenum, sufficient to keep the duodenal mucosa constantly bathed in bile, permitting the duodenal cells to absorb the bile tint, just as we find all of the mucosal linings of the gall-tract itself are heavily bile stained. This differential point, too, is again easy of check-up by referring to the previous findings for fasting biliary regurgitation and the presence of a discharging bile in the fasting duodenal state. Where we find the duodenal elements bile tinged we can very frequently look for the source of the infective duodenitis in the gall-tract.

In all of these cytological examinations the extent and severity of the catarrh can be quantitatively estimated by the numbers of flocculi left unexamined in the specimen bottle when compared with the amounts used in one or more microscopical spreads; remembering that one or two drops from a pipette will practically supply a cover slip preparation, and give an enormous amount of cytological evidence. Therefore it will be seen that the cytological evidence is of real importance *only when considered from the quantitative side*. All records should be kept on a quantitative estimation. A classification of O + 1 to + 4 usually covers this.

In *cholecystitis* and in *catarrhal states of the gall-tract* in general we can adopt practically the same classifications as those described above for duodenitis, but here we have further to differentiate as to whether *all* of the gall-tract is involved, including the gall-bladder and ducts below the liver, or whether the gall-bladder itself is relatively normal and the process confined to the ducts. Especially important is a differentiation between cystic and common duct catarrh. Cytological evidence from all points within a gall-tract properly drained will show rather deep bile staining of all microscopical elements.*

The epithelium lining all parts of the gall-tract is of the columnar variety, but in a general way the height of the columnar epithelium is indicative of its source. By that I mean the height of the individual columnar cell bears a definite relationship to the caliber of the portion of the gall-tract from which it is derived. The lumen of the gall-ducts becomes progressively larger as they pass downward from the perilobular bile-ducts to the termination of the common duct at the ampulla of Vater. Therefore, when we find *tall* columnar epithelium we can obviously assume that this cannot be derived from the smaller ducts, since the lumen is too small to contain a tall epithelium and its source is therefore more apt to be from the common duct or from the gall-bladder itself.

In the case of *short* columnar epithelium this rule cannot hold, inasmuch as this type may conceivably be derived from any portion of the gall-tract and our criterion then is to note carefully the bottles

* It is most important that flocculi in bile be examined very promptly. (See Figs. 114 and 115 and compare with Figs. 127 and 128.)

PLATE VII

FIG. 1

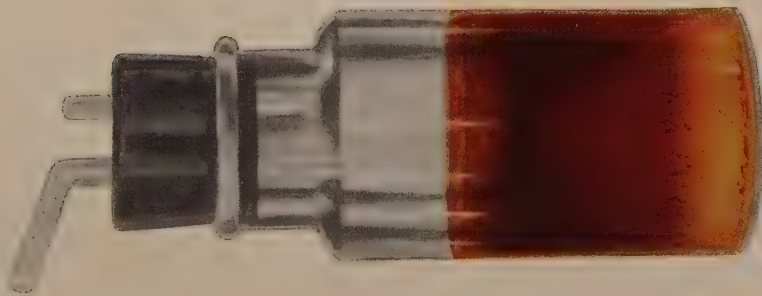


FIG. 2

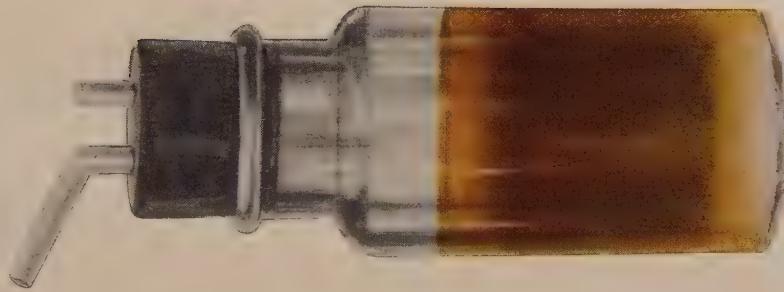
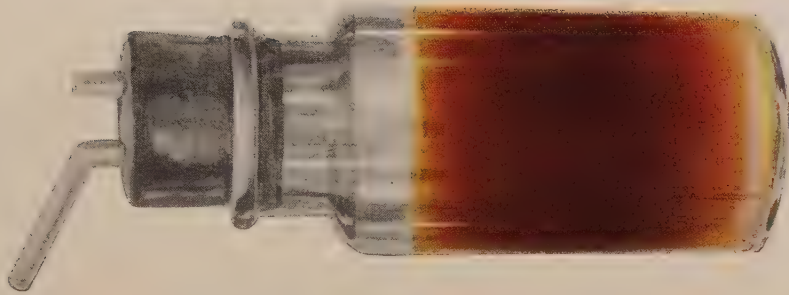


FIG. 3



Pathological B, Gall-bladder Fractions.

Fig. 1. From case of splenomegaly with hemolytic jaundice with streptococic infection. Fig. 2. Chronic cholecystitis with "masked" infection. Fig. 3. Chronic cholecystitis with "masked" infection and moderate stasis.

("A," "B," or "C") in which this short type of epithelium is most plentifully found. For instance, if it occurs in both "A" and "B" bottles together with taller columnar epithelium but still continues to be found desquamating in abundance in our "C" or liver bile after the gall-bladder has delivered its contents and the common duct has been flushed, we may then assume that the catarrhal process extends up into the smaller ducts within the liver substance.

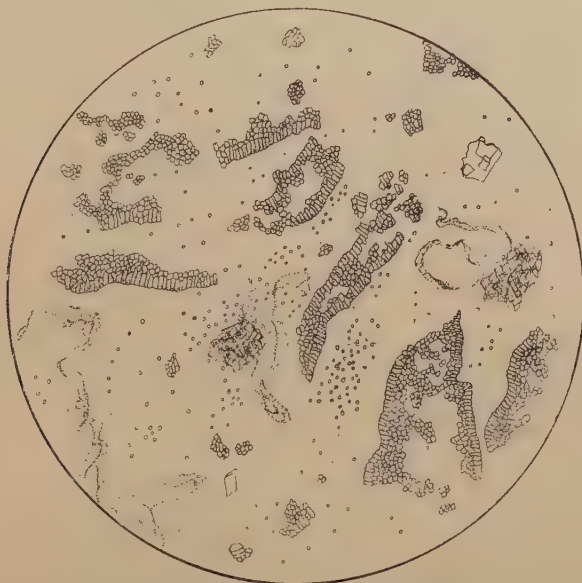


FIG. 113.—Short columnar bile-stained epithelium, presumably from gall ducts (conceivably from any part of gall-tract). Contrast with tall columnar epithelium from gall-bladder. (See Figs. 114 and 115.) $\times 385$.

The *very tallest* columnar epithelium, however, I believe is only derivable from the gall-bladder itself, and this type, while frequently appearing in individual cells or groups of cells, is more easily recognized as gall-bladder epithelium when it is found in large masses, in fan-shaped clusters or rosette forms. These fan-shaped clusters frequently appear to have been broken off at a basement membrane from a reticulated fold of a gall-bladder rugæ. The rosette forms can be produced by the ends of one of these fan-shaped masses being brought together in the form of a circle. (See Figs. 114, 115 and 116.)

In *choledochitis* alone the "A" bottle will contain numerous flocculations which will cease to appear or become distinctly less numerous as the gall-bladder bile is being expelled. The micro-

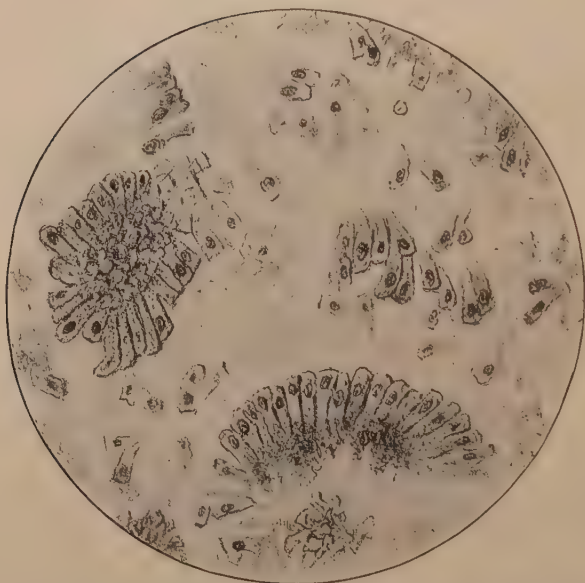


FIG. 114.—Heavily bile stained tall columnar epithelium from gall-bladder. Note arrangement of cells in fan shaped masses and clusters. Cells fairly well preserved with retained nuclei and comparatively little degeneration of cytoplasm. $\times 385$. Compare with Figs. 127 and 128.

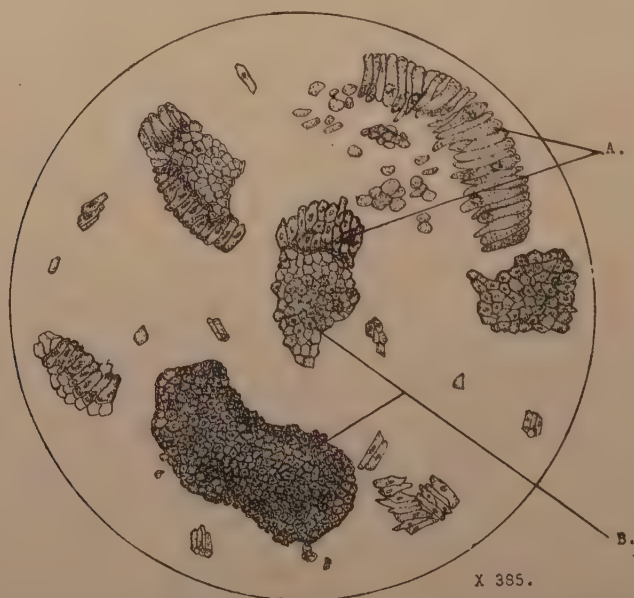


FIG. 115.—Types of gall-bladder epithelium seen in catarrhal exfoliative cholecystitis. $\times 385$. A. Tall columnar bile stained epithelium; B, epithelium suggesting liver cords, but probably tall columnar epithelium seen in cross-section.

scopical examination of these flocculi will show strands and sometimes wide ribbons of mucus, often heavily encrusted with amorphous bile salts, varying amounts of tall, medium or short columnar epithelial cells, singly or grouped into masses or layers of three to six cells when the catarrh has assumed the exfoliative type. There will be found leukocytes or pus cells in numbers somewhat

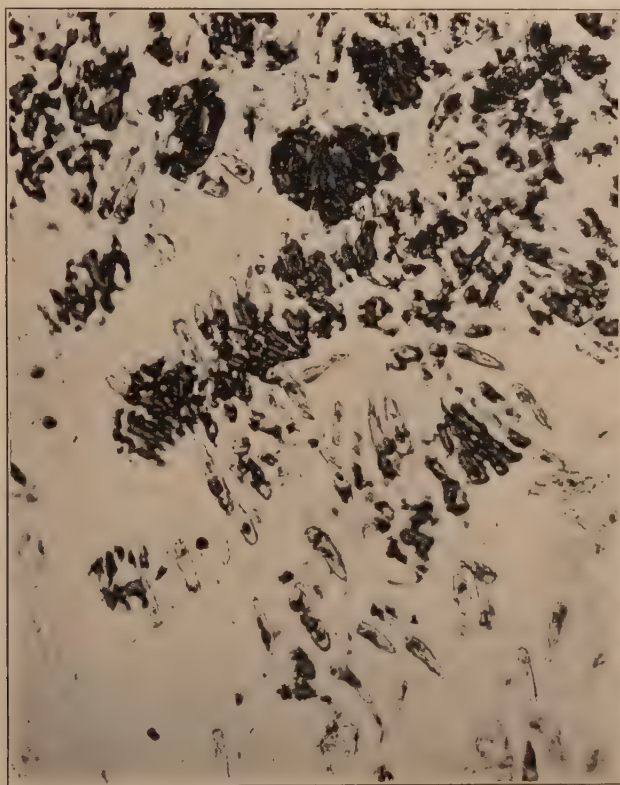


FIG. 116.—Photomicrograph of tall columnar epithelium scraped from gall-bladder mucosa. $\times 385$. Note: It is very difficult to photograph fresh cells (unfixed and unstained) on account of inability to bring out detail of all cells because of variation in focus.

proportionate to the extent of the inflammatory process. There may be much amorphous inflammatory débris and occasional red blood cells. Where frank or gross bleeding is observed Sachs (3) believes this a differential point in favor of cancer.

Where the degree of catarrh is sufficient to partially obstruct the common duct the flocculations are more numerous, the mucus

strands more dense, and the epithelial elements show a less perfect morphology and a tendency to necrotic degeneration. Where bacterial infection is added to simple or exfoliative catarrh we find, many fields swarming with them, and masses or colonies of bacteria in intimate relationship with the strands of mucus or clusters of epithelial cells.

In certain cases of the choledochitis of simple catarrhal jaundice due to an extension in the common bile duct of a catarrhal duodenitis some of the microscopical evidence encountered is very interesting and convincing. I have seen quite a number of cases of catarrhal jaundice which I have treated by magnesium sulphate biliary tract drainage show the following sequence. If the obstruction of the common duct is complete and due to a catarrhal or mild inflammatory state of affairs the duodenal tube will fail to recover any bile from the duodenum. The duodenum is then douched with the magnesium sulphate solution at hourly or two hourly intervals using fractional doses of 15 cc of the 33 per cent volumetric solution and between stimulations constantly dripping into the duodenum hot water, or normal saline. By degrees flocculi will be discharged and bile tinting of the fluid appears until quite often there will be recovered a dense mucus plug or cast from the common duct, 1 to 3 cm. long and 3 to 5 mm. in diameter, which will hold its shape for several hours, and can often be preserved in formalin and kept for many weeks. (See Fig. 117.) Following the expulsion of this plug of mucus bile will be discharged freely and sometimes with extraordinary velocity from the bile engorged liver and the jaundice may be completely gone in from three to ten days depending on the depth of the jaundice. Now an interesting fact is this: That if the mucus plug be examined carefully one end of it, that from the duodenal side will be unbile stained, while the other end, that from the common duct, will be definitely bile stained. Furthermore, microscopical examination of the unbile stained end will show cuboidal or oval epithelium, pus cells and mucus and occasionally bacteria, whereas the bile stained end will show columnar epithelium, albeit often necrotic, together with other inflammatory elements.

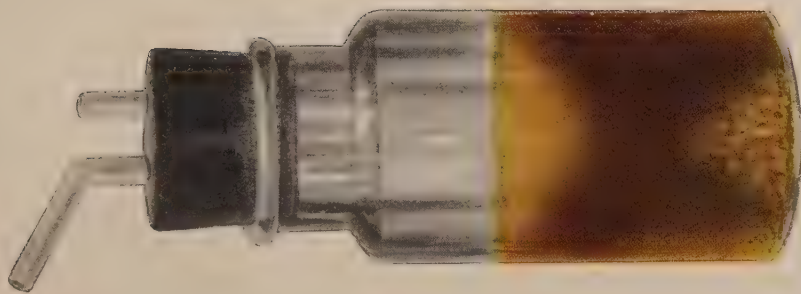
In certain cases, much less frequent, the catarrhal process will extend into and obstruct the major pancreatic duct of Wirsung and the mucus plug that is expelled will be roughly Y or V shaped, as witness Fig. 118, on page 329, very kindly furnished me by Dr. James B. Luckie, of Pasadena, California. In this case Luckie found not only a complete obstruction of bile, but also a *complete absence of pancreatic ferments* before this plug of mucus was expelled, with their prompt reappearance after its discharge.

PLATE VIII

FIG. 1



FIG. 2



Pathological B, Gall-bladder Fractions.

Fig. 1. From case of acute exfoliative cholecystitis. Fig. 2. From cholecystectomized patient, with postoperative liver and duct infection and catarrh. (Note mucopurulent flocculi).

Cystic Duct Catarrh.—Here we find the flocculations appearing most numerous just before gall-bladder bile is being delivered. When the cystic duct obstruction is complete no "B" fraction is recovered. These flocculations are usually more compact and



FIG. 117.—Illustrates a dense plug of mucus extracted from the common duct and recovered in the drainage bottle from a case of catarrhal jaundice. The recovery of such a perfect mucus cast of the common duct is the exception; more often the obstructing mucus is brought away in small pieces over a series of drainages.



FIG. 118.—Illustrates a dense plug of mucus which obstructed both the common bile duct and the major pancreatic duct and recovered from a case of catarrhal jaundice.

dense, and frequently have a characteristic *spirillation* which suggests their source as being from the rifle-like convolutions of the cystic duct. Under microscopical examination these mucus flocculi frequently preserve a definitely twisted or spiralled appearance even

when pressed out by the cover slip. They are heavily encrusted with amorphous bile salts, and frequently more so, I believe, than in mucus from the common duct. Leukocytes, bacteria and inflammatory debris likewise appear and are classified and interpreted according to the criteria set down above. Where this cystic duct catarrh has developed to an extent sufficient to cause cystic duct obstruction we have commonly found, in addition, the following phenomenon. Among the light grayish-yellow mucopus flocculi we can often pick out denser shreddy flakes of a bright yellow color which microscopically prove to be very dense shreds of mucus (often twisted and spiralled), heavily encrusted over with amorphous bile salts, bacteria and occasional pus cells, but, in addition, in close association with the mucus shreds, are found innumerable globules of apparently neutral fats. I say apparently neutral fats because they take up quite readily the Sudan III stain, but, on the other hand, do not show any tendency to be dissolved by ether. If such a microscopical slide is examined on a warm microscopical stage it will be seen that these individual globules seem to melt down quite rapidly into confluent pools which coalesce into lakes of the same bright yellow oily looking material. This oleaginous material is so fluid that with air currents passing under the cover slip it is seen to move in rather freely flowing streams between the strands of dense mucus. If these bright yellow mucus flecks are pipetted out of the recovery bottle into a porcelain dish and are pressed out by the finger or a spatula they will be seen to coat the side of the porcelain dish much as though you were smearing it with butter. This phenomenon I have seen so frequently occurring in cystic duct obstructions as to make it appear a reliable diagnostic deduction.

I have at present no explanations to offer for this repeated observation. It may be somewhat concerned with some chemical change that may take place in the mucus itself or from a degenerative dissolution of epithelial cells or from a disturbance in physiological chemistry of some element in the bile about which as yet we know nothing, for this phenomenon is not observed in *all* cases of cystic duct obstruction, and apparently does not take place where the mechanical obstruction is due to factors outside the lumen of the duct.

Failure to Recover "B" Bile.—I have frequently found in a diagnostic study that I was not able to drain any of the second type darker colored and grossly different "B" bile, and in searching for explanations of this, I believe that the following list of differential possibilities will cover practically all cases. These may be divided into five main groups:

I. Obstruction of the cystic duct which may be due to the following causes.

A. 1. The mucous membrane of the cystic duct may be inflamed, swollen and congested, in other words in a state of inflammatory edema.

2. It may be choked.

(a) By inspissated dense mucus, often spiralled or twisted and encrusted over with a dense precipitation of amorphous bile salts, and often showing an oleaginous material. (See Report of Case XXV.)

(b) Or by very fine gall-sand or the minutest gall-stones.

3. Or it may contain one or several larger stones which have become impacted.

4. Or there may have occurred localized irritation of the true branching racemosed glands which occur almost exclusively at the neck of the gall-bladder or the very commencement of the cystic duct. In states of inflammatory edema surrounding this localized glandular inflammation the cystic duct may become completely blocked, so that bile can neither enter nor leave the gall-bladder and a hydropsical mucoid fluid may be secreted by these racemose glands, as well as by the mucous membrane of the gall-bladder itself. Under such circumstances, in certain cases, the gall-bladder becomes so distended as to be readily palpable, but without the production of jaundice.

B. 1. Adhesions involving the cystic duct.

2. Angulations of cystic duct by pressure or otherwise.

3. Stricture of cystic duct.

C. By pressure exerted upon the cystic duct from without, as by

1. Neighborhood tumors.

2. An enlarged lymphatic gland or glands lying along the cystic duct. The commonest point at which such obstruction takes place is at the distal extremity of the cystic duct close to its union with the hepatic duct. Therefore, if this swollen gland exerts enough pressure to block off the hepatic duct as well as the cystic duct jaundice will be produced. Jaundice may similarly occur when the distal end of the cystic duct is obstructed from within, due to impaction of a calculus exerting sufficient pressure to block off the hepatic duct.

II. The cavity of the gall-bladder may contain relatively little or absolutely no recognizable bile in the event.

A. That its entire capacity may be filled with multiple calculi of varying sizes,

B. Or a large solitary stone around which the gall-bladder has contracted,

C. Or the gall-bladder may be in a state of complete atrophy or

fibrosis, and at operation may be found to represent only its vestigial remains.

None of these conditions will of themselves produce jaundice, although they may occur in cases presenting jaundice produced by other causes. (See Report of Case XIV.)

III. The bile contained in the gall-bladder may be so ultra-static and of such tarry consistency as to be too thick to flow of itself, or the gall-bladder musculature may have become too weakened to force it through the cystic duct.

IV. Adhesions angulating the gall-bladder in such a manner as to prevent discharge of its bile.

V. **Atony of the Gall-bladder.** Relative atony of the gall-bladder is something I believe we can now diagnose and which I believe to be of extreme importance, because I believe it to be one of the earlier phases of gall-bladder disease and often the forerunner of gall-stones and of gall-bladder infections (see page 117). This diagnosis is suggested in three ways:

1. *By the recovery of static or "off color" bile*, ranging from the deeper shades of golden yellow-brown into the green-yellows, green-browns, green-blacks and blacks, and possessing an increased viscosity from that of a thick syrup to that of tar. Where the viscosity is heavy and the cytology shows much mucus and desquamating masses of bile stained tall columnar epithelium and quantities of precipitated crystals I consider this an atonic catarrhal cholecystitis and a potential forerunner of calculi. I have not only seen this type alone, but also appearing as the type of infected cholecystitis with a swarming bacterial flora, bacterial colonies, pus, red blood corpuscles and inflammatory débris. This is the out-spoken type of cholecystitis which gives rise to well marked clinical symptoms. But I have also frequently seen the "masked" infected cholecystitis with swarming bacteria and static bile, but *no* cytological inflammatory reaction or marked cellular destruction. These are the cases that are, from a pathological standpoint, in an early stage, and which do not show interpretable clinical symptoms, but give rise to the mixed syndrome (see page 98), or to the vague atypical dyspepsias. These, too, are the gall-bladder infections which operatively are passed over as being grossly normal, in which the appendix is removed and the masked focus left to breed pathological conditions. It is in this group of patients that I believe the direct diagnosis by means of medical drainage offers the only possibility of early recognition.

2. *By the Amount of Static Bile Recovered.* If the capacity of a normal gall-bladder may be considered as not to exceed $2\frac{1}{2}$ ounces, and if 4 ounces of this type of bile can be recovered in bottles (remembering that all of the bile is not capable of recovery, some pass-

PLATE IX

FIG. 1



FIG. 2

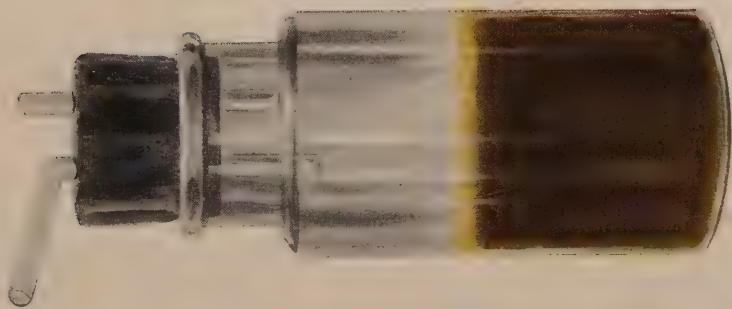


FIG. 3



Pathological B, or Gall-bladder, Fractions.

Fig. 1. From case of chronic cholecystodochitis with cholelithiasis. (Note increased flocculi). Fig. 2. From case of streptococcic cholecystitis. Fig. 3. From case of gall-bladder atony with migraine.

ing down into the jejunum), it seems reasonable to assume that the gall-bladder in question must be functionally atonic and unable to move its contents promptly, or the cystic or common ducts must be partially obstructed. If 6 to 12 or more ounces of this static bile is recoverable, as seen in certain of my cases, it must suggest that the normal distensible sac has been overdilated, has become dilated and perhaps ruptured some of its muscle fibers, and may be progressing to an absolute atony. I used to feel that it was a safe procedure to attempt to estimate the size or the capacity of the gall-bladder by the amount of the dark colored static bile which was recovered. But I believe now that this is not a sound conception inasmuch as a relatively small amount of very thick, tarry black bile can be so diluted with the stream of light yellow or straw colored liver bile as to give us several ounces of a brown or green-black bile (see page 148). I do believe, however, that we can recognize a functional type of relative atony as described above for the further reason that this type seems to fit in so well with many of the cases presenting symptoms of so-called biliousness and of cyclic migraine attacks (see page 517). These also are groups that may be forerunners of gall-stones and the later gall-bladder or gall-duct states of pathology.

3. *By the Intermittency with which the "B" Bile is Delivered.* In normal cases when "B" bile is recovered it comes continuously until replaced by the appearance of "C" bile, and averages from 1 to 2 ounces and further stimulation with magnesium sulphate fails to recover any more. Whereas when atony may be suspected, "B" bile appears slowly and is static or "off color" in varying degrees, but the gall-bladder discharge may be intermittent, that is to say, 2 or 3 ounces of "B" bile and then 10 to 30 cc of "C" bile and again 1 or 2 or more ounces of static "B" bile. This is seen more frequently if the duodenum is *restimulated* with magnesium sulphate two or three times. It is reasonable to suppose that such gall-bladder musculatures are deficient in tone and incapable of emptying their contents completely, as in atony of the urinary bladder with its residual urine.

Some of these cases represent "physiological block" as contrasted with "mechanical block" illustrated by conditions found under Group I. For further elaboration see Chapter XXIII, page 438.

There are limits to the amounts of magnesium sulphate that should be retained by the patient. I have adopted a limit which I consider safe for adults, unless constitutionally asthenic or enfeebled by age or their disease, and routinely place this limit at 90 cc of the saturated solution that may be retained by the patient. My custom is to start with a first stimulation of 75 cc of the 33 volumetric per cent solution, allow this only to douche the duo-

denum, to recover all that I can, and note how much appears in the bottle unmixed with bile. If I recover say 40 cc I have then a balance to the amount of 55 cc for repeated fractional stimulations,



FIG. 119.—Drainage, well established, recovering several ounces of inky black bile from atonic gall-bladder. Note test tube "set up" for phenoltetrachlorphthalein test of liver function. Note microscope ready to hand for prompt examination of bile flocculi for cytological examination.

and still keep within the total limit of 90 cc to be retained. The second stimulation is usually given with 45 cc and the third or fourth with 30 cc each. It is not necessary that the magnesium sulphate be

retained by the patient in order to get an efficient drainage. Olive oil may be used instead of magnesium sulphate (see page 319) and at times is the stimulant of choice.

In a diagnostic drainage, therefore, performed on a non-cholecystectomized patient, where we fail to recover "B" bile, we must give careful consideration to the preceding differential possibilities. In the beginning of this work when I encountered this condition I felt that it was a distinct indication for surgical interference. I have learned since, however, that a diagnostic medical drainage with magnesium sulphate or olive oil should be repeated at least two or three times before we come to this final conclusion, for I have been surprised to find that by carrying out this plan, whereas on the first drainage I had recovered only "A" (common duct) and "C" (liver) biles, and only the slightest suggestion or none at all of "B" (gall-bladder) bile, that on the second, third or fourth drainage, in certain cases, a very definite transit to "B" bile took place, and as further drainages were carried out the gall-bladder was found to empty itself more successfully and deliver larger amounts of a deep green-black, thickened and static bile. It seems reasonable that this could only occur in conditions of atony of the gall-bladder musculature of an incomplete degree and possessing a residual tonus still capable of gradually responding to the repeated magnesium sulphate or olive oil stimulation. (See Report of Case XI-A, page 539.)

Even after having proved this diagnostic point I believe that the majority of such cases are to be considered primarily surgical. But before definitely committing ourselves to this step it is good judgment to review all factors brought out in the complete diagnostic study of the patient to determine whether there are any conditions present in the heart, lungs, kidneys or endocrine systems which can be considered contraindications that would increase the mortality risk. In such an event if we have been able to prove by repeated diagnostic drainages that there is some hope of draining the gall-bladder in this particular case, as well as the ducts and liver, we then have secured for this patient an alternative plan of treatment by medical drainage, which, if carried out, may so improve the condition of the heart or kidneys as to make operative interference more safely possible later on. If, on the other hand, we find that, notwithstanding repeated attempts, we are not able to drain this particular gall-bladder we can then squarely face the situation and decide that notwithstanding the definite surgical contraindication there is no other alternative method of treatment, and either surgery must be resorted to or the patient must let Nature take care of future events.

I have also found that it is possible in certain cases to overcome

an obstruction of the cystic duct when due to inflammatory edema and intraduct catarrh, as will be seen by a review of the case reports. Certain of these cases who present more acute clinical pictures and more pronounced physical findings of upper right quadrant rigidity and spasm, with chills, fever and leukocytosis, should be put to bed for a few days with either an ice bag or external heat and an exclusive diet of hot liquids, if the stomach is retentive, in order to quiet down the acute inflammation before repeating the diagnostic drainage.* Whereas in other cases less acute, in addition to putting them to bed as above, a duodenal tube should be passed to the proper point in the neighborhood of the papilla of Vater and kept in place for a period of from twenty-four to seventy-two hours, during which time the duodenum is kept constantly bathed with hot Ringer's or normal salt solution instilled by a Murphy drip apparatus, and not more than two or three times in each twenty-four hours the duodenum should be douched with a 33 per cent (volumetric) solution of saturated magnesium sulphate in 75 cc amounts and as much of this recovered as possible to avoid excessive laxation, or olive oil stimulations may be substituted. During this period in which the tube is kept in place the patient should be given hot liquids to drink, preferably hot meat broths or beef extracts, which, in passing through an acid stomach, will be converted into peptones, albuminoses and proteoses, which we believe to be the normal physiological stimulus for evacuation of the gall-bladder contents. So, too, a hot 5 per cent to 10 per cent solution of Witte's peptone or of 0.5 per cent hydrochloric acid may be directly instilled into the duodenum two or three times a day. By this direct application of *internal* heat it is frequently found possible to more promptly allay the inflammatory condition and decrease the inflammatory edema or catarrh which is obstructing the common and cystic ducts.

If the historical study of the case suggests that the obstruction of the cystic duct might be due to an impacted stone, a word of caution should again be spoken against the advisability of carrying out the above procedures, because the instillation of magnesium sulphate, olive oil, or of Witte's peptone by stimulating the gall-bladder to contract might possibly encourage a perforation of the cystic duct, although I have never yet seen or known this to take place following the use of this method. Nevertheless it is a conceivable possibility and should be carefully borne in mind.

Cholelchitis and Cholecystitis.—Aside from an analysis of the history and physical examination, the differential diagnosis between cholelchitis and cholecystitis depends to a large extent upon the bacteriology and cytology, plus the gross normality or abnormality

* See Report of Case XXII, page 568.

of the bile as discussed on pages 324 to 328. Of course, if the gall-bladder has previously been removed the problem is much easier.

Empyema.—Empyema of the gall-bladder is easiest to diagnose directly by medical drainage provided the gall-bladder is mechanically able to discharge a specimen of its contents. On several occasions I have been able to recover an ounce or more of practically pure pus from patients who, at operation, were found to have an

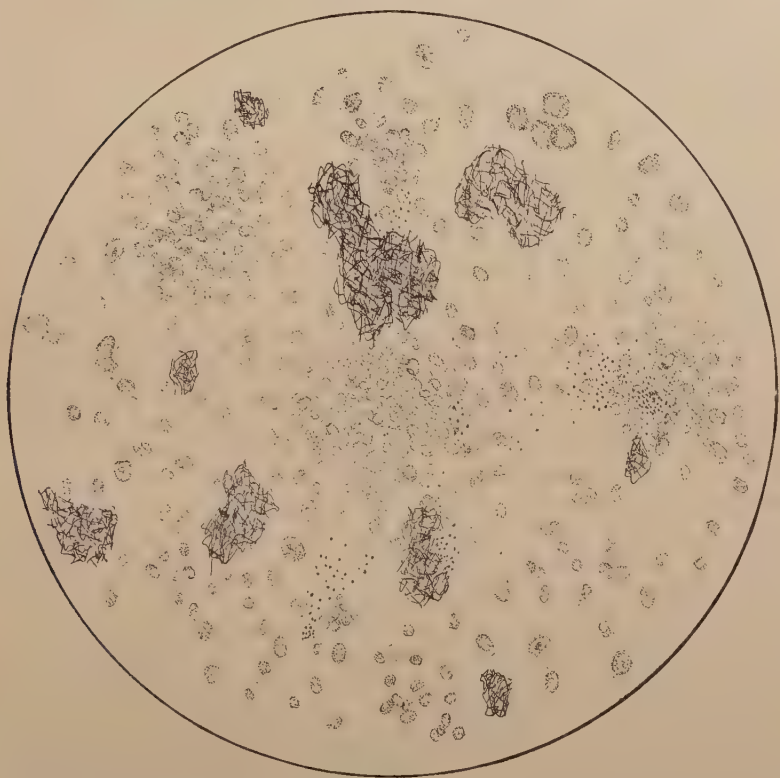


FIG. 120.—Practically pure pus, with occasional necrotic epithelial cells and masses of bile pigment from a case of proved empyema of gall-bladder. $\times 385$.

empyema of the gall-bladder.* Other men, have been able to confirm this diagnostic finding. Indeed I have been able to successfully drain several such cases and have brought about such a relative symptomatic recovery that operation has still been declined on the part of these patients, and I am convinced that where it is possible to prove by medical drainage that the pus can be evacuated by way of the duodenal tube this method may be substituted as an

* See Fig. 120.

alternative in cases in whom surgery is contraindicated, and may tide them over temporary surgical contraindications until they can be better prepared to stand the operative risk.*

Cholelithiasis.—Regarding the diagnosis of cholelithiasis, some helpful points can now be suggested. Of course, the recovery of gall-stones themselves or of gall-sand is the *sine qua non* of this diagnosis. I have recovered small concretions *through* the duodenal tube in one instance, and on several other occasions have made stones pass either out of the gall-bladder or out of the duct, stones too large to be recovered by the tube, but found on sieving the stools. Indeed, in any case in which medical drainage is followed by a severe attack of biliary colic or of pain which reproduces any of the pain attacks described in the history (see page 542), the stools should be carefully washed through a sieve, a piece of gauze or a handkerchief for possible stones.

In none of these cases cited above do I feel that this occurrence would have happened at the time of the diagnostic or therapeutic drainage if magnesium sulphate introduced locally did not possess the power to relax the duct sphincter and to stimulate the gall-bladder either to contract (?) or by some other process evacuate its contents. As Meltzer pointed out, magnesium sulphate loses much of its power to act in such a manner in the duodenum if it is first passed across the gastric mucosa. This is probably due to the fact that the average stomach contains some, and in many instances a superabundance of hydrochloric acid, which apparently alters the magnesium sulphate so that it is no longer magnesium sulphate, certainly not in its concentrated dosage, when it reaches the duodenum. (See page 90.)

Next in diagnostic importance to the direct recovery of definite gall-stones, gall-sand and the sense of grittiness to the finger suggest the calculus forming possibility. So does the microscopical finding of large masses, often agminated, of precipitated crystals of cholesterin, calcium, bile salts or pigments, since it suggests either that the liver cells have lost their power to secrete a bile which is normally capable of holding these substances in solution, as may occur in the formation of liver or hepatic duct stones in the presence of stasis; or that the bile in the gall-bladder has become so sluggish or static that excessive concentration and crystalization of its bile has taken place.† The microscopical finding of crystals as explained on page 150 does not necessarily indicate the presence of formed calculi, but it does suggest a precalculus stage in their formation.

I have previously shown that the sudden dense turbidity that one sees now and again taking place in an otherwise perfectly

* See Report of Case xviii, page 556,

† See Figs. 121 to 126.

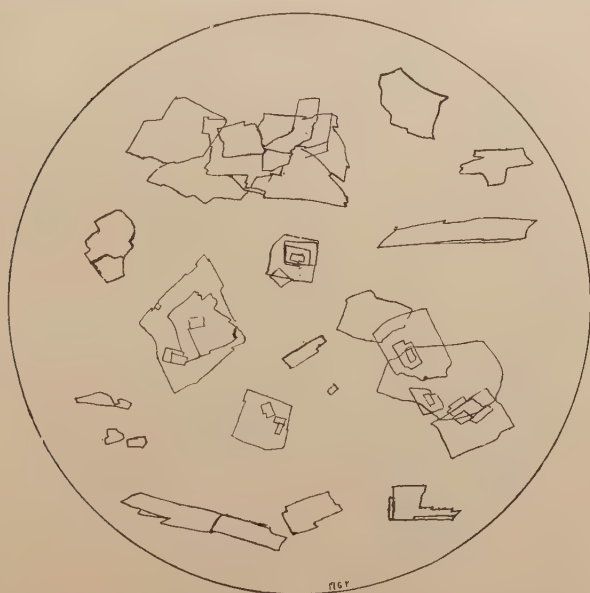


FIG. 121.—Cholesterin crystals recovered by duodenobiliary drainage, diagnosing gall-stones with negative roentgen ray. $\times 385$.

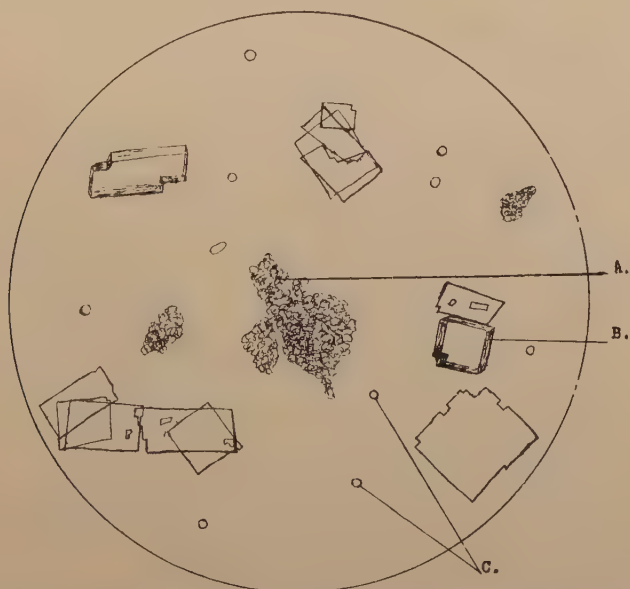


FIG. 122.—Cholesterin crystals, with clumps of bile pigment, recovered in bile from gall-bladder containing one large mulberry stone, diagnosed by drainage. $\times 385$. Cf. Fig. 121 and note thicker crystals obtained directly from gall-bladder.

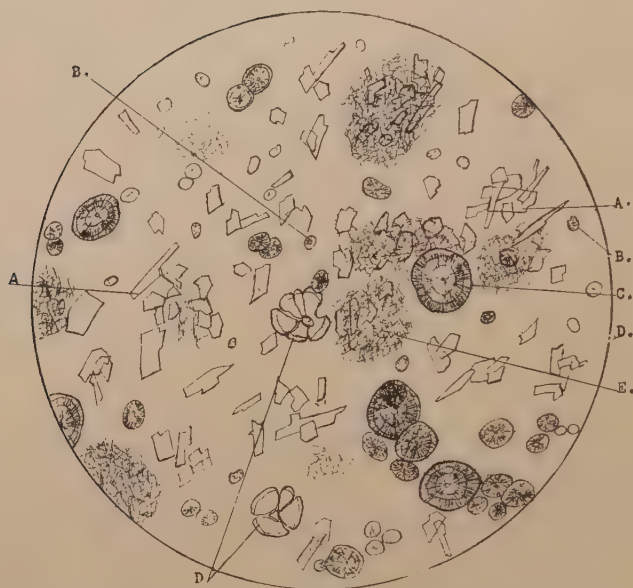


FIG. 123.—Dr. S., July, 1921. "B" fraction supersaturated with various crystals. $\times 385$. A, Cholesterin and calcium crystals; B, pus cells; C, leucin (?) crystals; D, leucin crystals undergoing spontaneous fracture; E, masses of bile pigment.

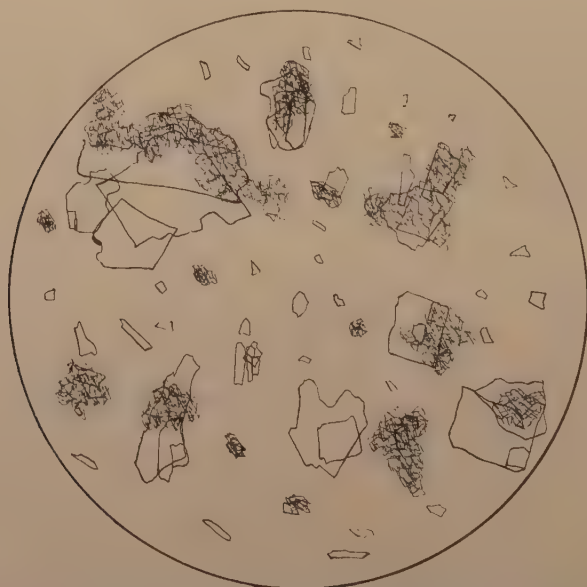


FIG. 124.—Scrapings from outer shell of gall-stones recovered from Dr. S., operated January, 1922 (see Report of Case XI). $\times 385$. Compare with Fig. 123 and note similarity in crystals except absence of leucin (?).

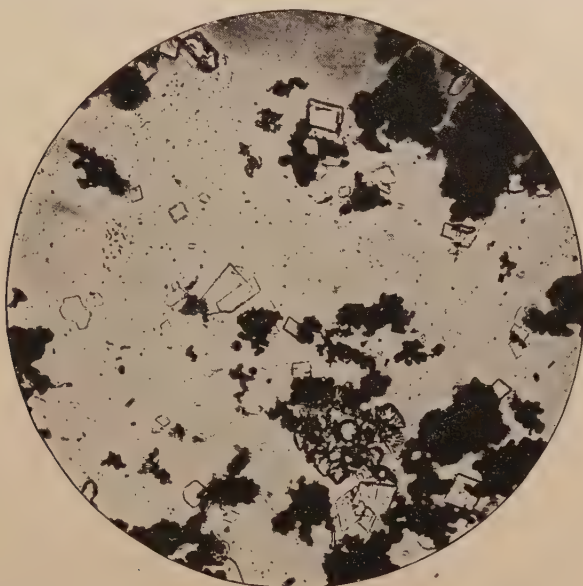


FIG. 125.—Photomicrograph of crystals recovered from "B" fraction of Dr. S. *Note:* It is very difficult to photograph the fields from biliary-tract drainage and show details on account of inability to bring all cells, etc., into the same focus. $\times$ 385. Compare with drawing—see Fig. 123.

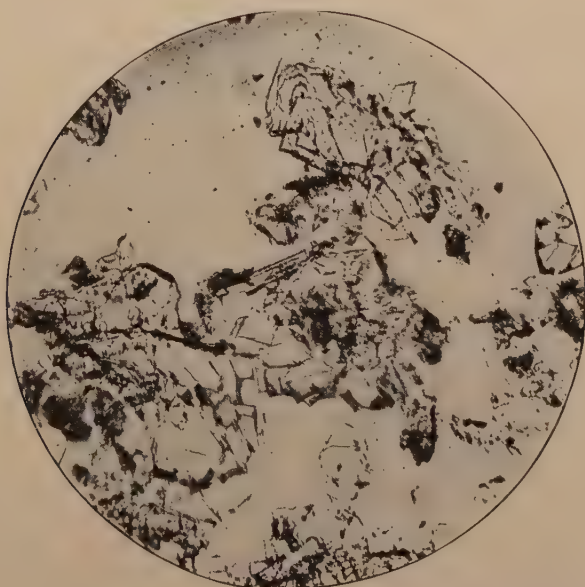


FIG. 126.—Photomicrograph of scrapings from outer shell of gall-stones recovered from Dr. S. $\times$ 385. Compare with Fig. 124.

transparent bile during a drainage is due to a sudden spurt of acid gastric juice entering the duodenum and mixing with the bile. This was confusing to me at first inasmuch as this emulsion so closely resembles pus, and it is still an annoying feature when one is attempting to make a careful segregation of "A," "B" and "C" biles. The use of the microscope in the examination of this emulsion will readily settle any doubts as to whether we are dealing with pus (see page 115). Dr. Bartle, working with me, found that this turbidity could be artificially produced in the case of every clear bile by artificially adding dilute hydrochloric acid. The depth of the turbid emulsion will be found to vary according to the strength of the acid used and the chemical constituents of the bile. Later on certain clear biles were occasionally encountered in which an *effervescence* as well as the turbidity was produced on adding hydrochloric acid, similar to the reaction of acetic acid and calcium carbonates in the urine, and the question has been suggested as to whether this might mean the possibility of potential or formed calcium carbonate or phosphate stones in the gall-bladder. More work must be done on this point. In such cases, however, one might expect to find positive gall-stone shadows by roentgen ray if this condition is due to a calcium diathesis.

The total diagnostic impression from a medical drainage of the gall-tract is then developed from close study of the data found and recorded on the biliary drainage sheet, interpreted in the light of the history and physical examination, and should embrace the findings which occurred in the stomach, the question involved in a delayed duodenal transit time due to the various causes outlined on page 311, and a direct study of the bile and the manner of its discharge—the promptness with which "A" and "B" biles appear, suggesting normal tonus, subtonus or hypertonus of gall-bladder musculature; and whether or not more than one stimulation with magnesium sulphate or olive oil has been required; the velocity and character of the discharge of "C" bile; the gross appearance of the several biles; their color, consistency, viscosity, transparency, turbidity, flocculations, mucus, etc.; and especially the careful examination into the cytology, *freshly examined while still warm** (epithelium, whether bile stained, its suggested source [see page 320], pus, leukocytes, crystals, concretions, amorphous salts, red blood corpuscles, mucus, bacteria and inflammatory debris as discussed on page 322); into the chemistry of the bile (cholesterin, calcium, pigments, lecithin, fat, effervescence on acidification); and into the bacteriology by culturation of each of the segregated samples of bile. (See page 347.)

It may be wise to again mention the fact that, in many of these cases, we are draining material from the biliary passages which

* See Figs. 127 and 128, and compare with Figs. 114 and 115.

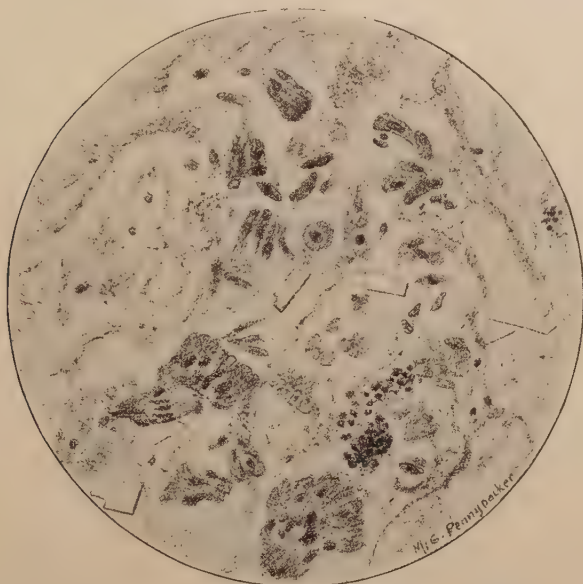


FIG. 127.—Tall and short columnar epithelial cells, bile stained, from gall-tract. Bile stained mucus and pus cells. Cholesterin crystals. $\times 385$. All cells in first stage of degeneration after standing in drainage bottle for one hour at room temperature.

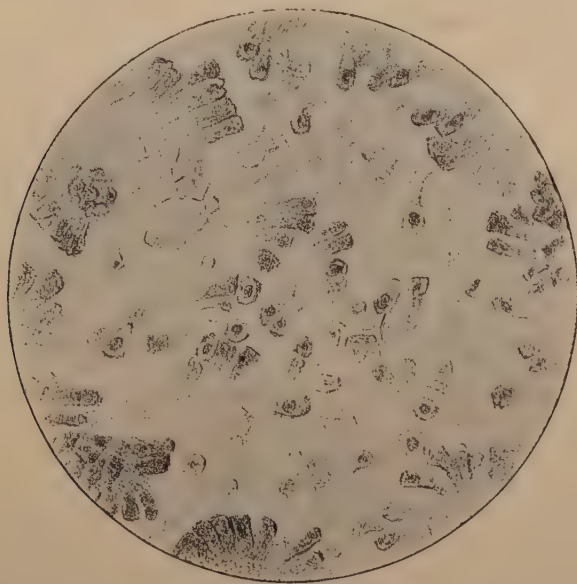


FIG. 128.—Bile-stained columnar epithelial cells from gall-tract in second stage of degeneration. $\times 385$. Note loss of nuclei, granular degeneration in cytoplasm and tendency to become "shadow" cells after standing in drainage bottle for two hours at room temperature. Hence the wisdom of prompt examination. Compare with Figs. 114 and 115.

is bacterially highly infected, and that some of this fails to be aspirated into the bottles, and in passing down the intestines may be able to infect susceptible zones lower down. It is by way of this route that I believe we so frequently see conditions of ileocolitis developing in patients following a gall-bladder removal, but in whom the ducts remain still infected, and also due to the fact that by the operation the ampulic sphincter control is usually abolished, this infected bile is continuously rather than intermittently being discharged into the duodenum. In order to protect the patient against such likelihood following a medical drainage there are two logical steps to be taken:

First, to attempt to protect the duodenum which receives the most concentrated bacterial dose by douching it with various disinfecting solutions, silvol, potassium permanganate, silver nitrate or mercurochrome as described on page 462. This step I do not think it wise to permit the patients themselves to carry out when they have reached the stage of continuing their drainage at home. All of these drugs are poisons if by mistake they are used in too concentrated strength, and there is therefore this element of risk.

The second protective step is to attempt to hurry along the infected material as rapidly as possible through the intestines. To do this I routinely follow each biliary drainage, whether for diagnosis or treatment, with a duodenal enema after the general method recommended by Jutte. (1) I prefer to use Ringer's solution on account of its healing qualities (although normal salt solution might do as well), which is reinforced by a 0.12 per cent to a 0.5 per cent sodium sulphate ($\frac{1}{4}$ to 1 teaspoonful added to 250 cc Ringer's solution), depending upon how much magnesium sulphate has failed to be recovered which would otherwise act as a saline laxative without sodium sulphate. In certain cases, however, in whom I have learned that the magnesium sulphate creates an uncomfortable intestinal tympanites due to relaxing the tonus in the intestinal wall, I find, as Soper (4) has already pointed out, that this can be helpfully overcome by the addition of the sodium salt which increases intestinal tonicity. For routine purposes the total amount of the duodenal enema is kept at 250 cc, introduced at 105° F. by the drip method, and should require at least twenty minutes for its introduction. This is usually effective in producing one or more large fluid or semi-fluid movements in from fifteen to ninety minutes, thus rapidly eliminating from the body the poisoned bile which has escaped into the intestines.

As a final procedure in a medical drainage no patient is allowed to leave my office without being given a cup of bouillon and some crackers. This tides them over the faintness of hunger and free intestinal evacuation.

The various steps recited in this chapter fulfil the diagnostic requirements of a medical drainage. For a therapeutic drainage the whole process can be considerably shortened, and is much simplified as will be seen in its discussion on page 456. I have often regretted that for the purpose of my own understanding of gall-tract diagnosis it has been necessary to make a diagnostic



FIG. 129.—Illustrates the method recommended of giving the duodenal enema or transduodenal lavage.

medical drainage so highly technical, time consuming and laborious. I realize that this militates very distinctly against its adoption and wide application by the profession in general. Nevertheless I maintain that unless a diagnostic medical drainage is conducted with this great degree of thoroughness often some of the most important diagnostic inferences which are possible to obtain will

be totally lost, and it is for this reason that I believe that certain doctors have gone on record as being antagonistic to this method, (see page 123). It is not because the method itself is fundamentally wrong or unreliable, but their failure to confirm certain points of its practical possibilities is because they are not actually performing a diagnostic medical drainage as it should be done.

I quite agree that a method of diagnosis that is as detailed and complicated as this, and which requires technical training and a certain knowledge of bacteriological and chemical methods is not suited to the requirements or training of the average practitioner, or even will it find a place in the office of many diagnosticians unless it is properly organized for the work. A single doctor who has become thoroughly familiar with the technic cannot himself run through in complete detail more than 2 or 3 diagnostic cases in a morning. If the demands on his office become greater than this it simply becomes a matter of training assistants, who need not necessarily be doctors, to carry on the technical procedures, and the installation of a proper system of recording blanks to short cut the clerical entries. (See Chapters X and XI). Under such organization it will be possible to simultaneously handle without diagnostic skimping a dozen or more such diagnostic studies a day.

A therapeutic medical drainage of the gall-tract can be carried out by any general practitioner of medicine who has become familiar with the rather simplified technic. Indeed there are already a number of nurses who have perfected their training in this respect, and I have a very large number of patients who have become so proficient in the method of treatment as to be able within a very short period to carry it out for themselves at home.

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CHAPTER XIX.

A. CLINICAL DISCUSSION OF BACTERIOLOGICAL METHODS. B. DISCUSSION OF BACTERIOLOGICAL TECHNIC.

THE bacteriological examination of the bile must be carefully conducted and should begin with the care exercised in preventing as far as possible bacterial contaminations from the tract above the duodenum, as discussed on page 307. After the culture has been properly taken and has reached the laboratory great care must be exercised in the frequency with which transplants are made to prevent streptococci, pneumococci (see page 356), and the *Bacillus typhosus* and other less hardy organisms, becoming overgrown by the more luxuriant colon groups, *B. pyocyaneus* and *B. subtilis*. Cultures should be made directly from the bile at the time of its withdrawal in the office, clinic or hospital, and they should be planted in Huntoon's hormone broth or glucose broth flasks (see page 357), and it is often wise to collect a third sample in a sterile test tube or flask.

In the beginning years of this work I used plain broth cultures and various solid media, plain agar, blood agar, and Löffler's blood serum, but developed too many contaminations, and too often failed to recover any bacterial groups except the *B. coli*, although in fresh spreads streptococci and staphylococci could be definitely suspected. For another year we tried a glucose broth from a formula in use at the Rockefeller Institute. This improved the results somewhat. But for the past two years we have discarded this, as well as all solid media, and have used Huntoon's formula with greatly increased ability to recover the pyogenic cocci. After initial growth is obtained in the hormone broth, subcultures are made on various solid media as may be indicated for the recovery of any special bacterium, as described on page 359. All cultures should be properly labelled and promptly sent to the bacteriologist or pathologist unless you are qualified to do the work yourself.

I have learned that I get more reliable cultures by planting the mucopurulent flakes, especially when heavily bile stained, that sink down to the bottom of the bottles, particularly those of "B" bile. These mucopurulent flakes are representative of material from the floor or walls of the gall-bladder, ducts or duodenum. Microscopically they show by far the more interesting and con-

clusive cytology and bacteriology. If more cultures at operation were taken from the mucopus on the floor of the gall-bladder, and not simply from the supernatant bile, I believe the average of positive cultures would be much higher than that found by Kelly, (2) whether the gall-bladder showed gross pathological changes or not. Withdrawing bile directly from the gall-bladder in the customary way by a sterile hypodermic needle and syringe often gets the supernatant bile only.

I wish again to most strongly emphasize the need for careful cultural technic and prompt examination. Much important differential diagnosis hinges on this.

In order to avoid a large number of contaminations from saprophytic or non-pathogenic organisms which I encountered at an earlier period in the work, and which were due to perhaps unavoidable carelessness in taking cultures in the usual way, Dr. Russell A. Richardson, Pathologist to the Methodist and Abington Hospitals, devised a culture flask which is practically "fool-proof" against contamination if properly used. It consists of an Ehrlenmeyer flask of 200 cc capacity into which is put 100 cc of broth. The flask is corked with a rubber stopper perforated for two glass tubes bent at right angles, the outer terminations of which are plugged with cotton. A little later this apparatus was slightly modified by Professor John A. Kolmer, by wiring and sealing in the rubber stopper and cotton plugs with a coating of paraffin. A set of three or more of these flasks, illustrated and prepared as described on page 350, is placed on the table by the patient's bedside, and as a transit from "A" to "B," or "B" to "C," bile takes place as observed through the glass cannula, or as any unusually likely looking mucopus flocculi appear in this window, the glass tube of the culture flask is heated in the flame of a Bunsen burner or alcohol lamp, melting the paraffin, and the cotton plug is picked out with a pair of forceps, sterilized by flaming, and attached to the rubber tube which has been disconnected from the *distal* end of the glass cannula. This represents a point in the duodenal tube which has been subject to the least contamination from sources outside of the patient himself. A number of drops of bile, certainly not less than twenty, is allowed to pass into the culture flask by gravity or by gentle suction from a 1-ounce aspirating bulb attached to the other limb of glass tubing.

I believe from what I have heard or from what has been written me from other men practising this method, that one of their chief stumbling blocks is in regard to the uncertain bacteriological evidence which they are securing. Those who have since adopted the technic, which I now describe, have told me that their work has closely confirmed my own observations.

Method of Taking Cultures of Bile.—1. In the beginning period I allowed the bile to drip out of the end of the duodenal tube into a culture tube of broth or agar, without taking any precautions against sterilizing the tubing. This resulted in frequent contaminations with spore-bearing, non-pathogenic bacteria partly due to this and partly because the cotton plugs removed from the test tubes uncovered the media and exposed it to air bacteria. This method was soon discarded.



FIG. 130.—Illustrates improper technic of taking culture.

2. It was thought possible to improve the technic and avoid contaminations by sterilizing the outer surface of the rubber tubing with a drop of carbolic acid or lysol, through which was plunged the needle of a sterile hypodermic syringe and the bile aspirated. This was then planted into the culture media by the usual open method. This plan (see Fig. 130) was also discarded for this reason, and because proper floccules could not be selected blindly through the tube, and when accidentally secured, tended to plug up the needle.

3. After Richardson devised the flask referred to (see Fig. 131)

this obviated the open culture method and permitted attaching one limb of the flask directly to the drainage tube system and attaching the other limb to an aspirating bulb (which, however, is only *rarely* needed to suck out very thick inspissated bile). The culture was then taken by thoroughly swabbing with alcohol, by a cotton applicator, the 8 inches of rubber tubing attached to the proximal end of the glass window (cannula), and then permitting the next few cc of bile to wash out the alcohol before connecting

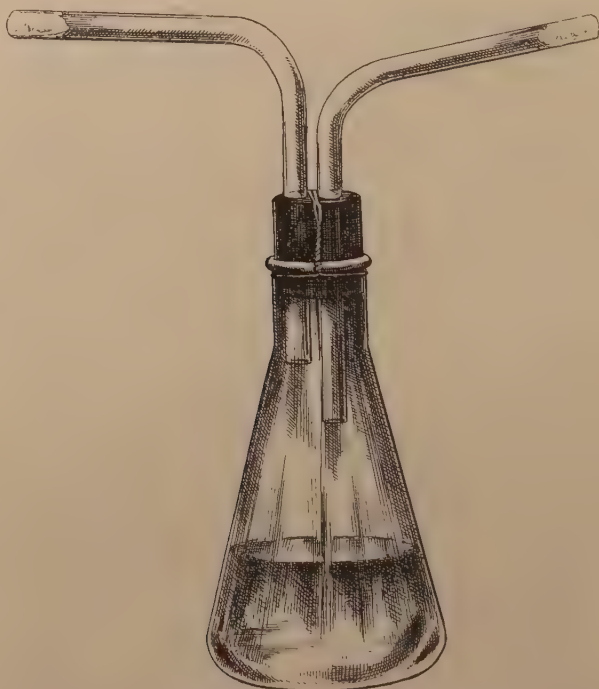


FIG. 131.—“Fool proof” culture flask for use in securing cultures from the stomach, duodenum or gall-tract

up the culture flask, so that the bacteria might not be attenuated. This method (see Fig. 132, page 351), improved the results noticeably, but had the disadvantage in allowing likely looking mucopus flocculi to escape during the time necessary to swab the tube with alcohol. This plan, too, was discarded in favor of the following one which is now my standard technic.

4. By the simple expedient of inserting a second glass window (or cannula) distal to the first and connecting with a piece of tubing large enough to fit over the connection on the culture flask the need

of sterilizing the proximal tubing is overcome, and we simply disconnect the tubing *distal* to the first cannula and attach to the culture flask direct, after flaming the glass limb as described on page 348. For this distal section of tubing does not come into contact with any outside contaminating sources. Furthermore, when likely looking bile or floccules appear in the observation window they can be promptly secured for culture. This method is the one recommended for adoption and is illustrated by Fig. 133.



FIG. 132.—Illustrates improper technic of taking a culture.

It is to be borne in mind that although all tubes, glassware, graduates, syringes, and so on are carefully sterilized before use, yet they cannot remain free from air contamination when exposed for two or more hours, and if proper bacteriological results are to be secured, any clumsy or careless method of taking cultures will only bring discouragement instead of intense satisfaction.

The above methods are all qualitative only. A good quantitative method is very much to be desired and might help us to determine where the source of the maximum infection of the gall-tract may

lie. This is still unsettled. Two methods, however, have been considered.

1. Suppose cultures from "D" (duodenal contents), "A" and "B," or "A," "B" and "C" biles *all* deliver, say, the streptococcus

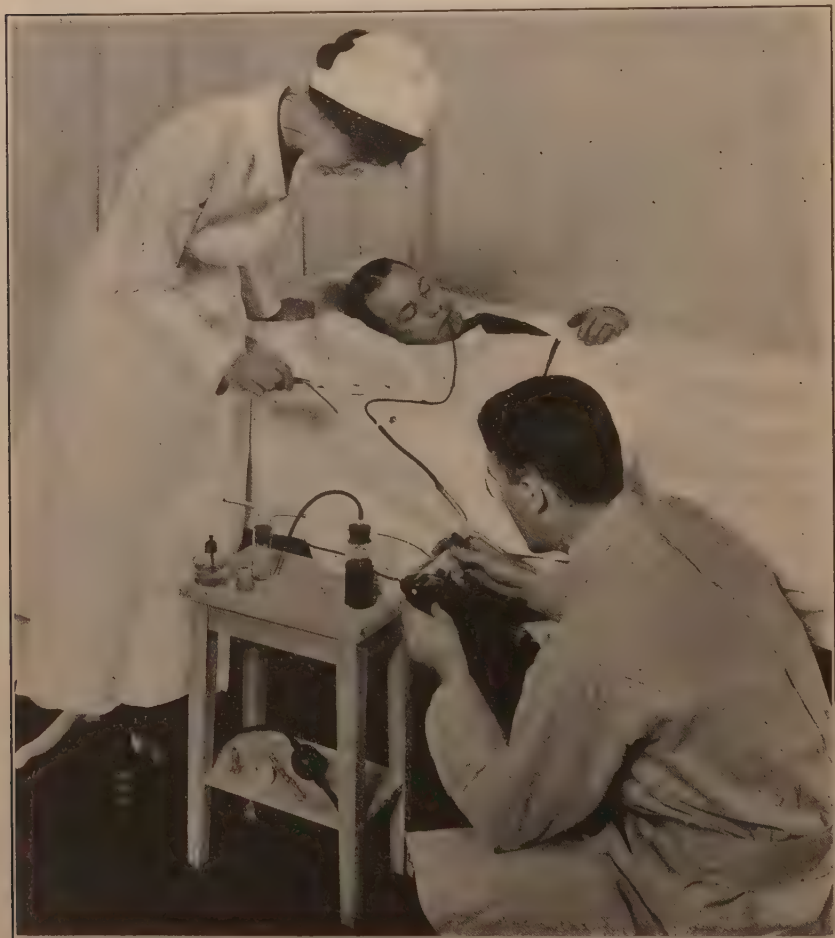


FIG. 133.—Illustrates the method recommended by the author for the taking of a culture from the stomach, duodenum or gall-tract.

from broth cultures, and we then plant the same number of loopfuls of the broth cultures from "D" and from "A" and "B" biles, and sow them through a series of blood agar Petri plates; and suppose we find that "A" bile grows out 7 colonies and "B" bile 94 and "D" grows out 9, can we reasonably conclude that the major

source of the infection is in the gall-bladder and not the duct or duodenum?

Similarly, if the colony counts from "C" bile are far larger than from "A" or "B" can we suspect the liver of harboring the major infection? Probably not, for from a bacteriologist's standpoint such a point of view is open to instant criticism.

2. Instead of planting the bile in broth cultures we take samples of "D," "A," "B" and "C" in sterile test tubes or containers and count the *number* of bacteria per cc and find that "B" sample has a very much larger number than have any of the others, can we then reasonably conclude that the gall-bladder is the major source of the infection? This comes nearer to being a true quantitative test, but must be tried out very carefully in a larger series of cases than Dr. Kolmer and I have yet studied. Still it appears to have promise. Both of the methods are mentioned here more to stimulate research interest than to prove the merit of any work yet done.*

B. DISCUSSION OF BACTERIOLOGICAL TECHNIC.

BY JOHN A. KOLMER, M.D.

Sources of Error and Importance of Technic.—Previous to the development of the method of duodeno-biliary drainage described by Dr. Lyon in preceding chapters, our knowledge of the bacterial flora of human bile was largely based upon the results of bacteriological studies of specimens secured in necropsies or aspirated from exposed and excised gall-bladders in surgical operations in the upper portion of the abdominal cavity. Studies of this kind have established in a general manner the role of various bacteria in the production of cholecystitis; also that human bile from the healthy liver and gall-bladder may sometimes contain various bacteria commonly found in the intestinal tract and notably bacilli of the colon group. Much less was known, however, of the bacteriology of the biliary ducts and their contents during life.

It is plain that the results of bacteriological examinations of bile secured during life are of more interest and importance than those made after death, since it is well established that invasion of the liver and other abdominal viscera with intestinal bacteria commences soon after death and reduces the value and significance of bacterial findings. For this reason any method increasing our opportunities for the bacteriological and other examinations of bile secured during life is to be welcomed as affording increased means for etiological studies of diseases of the liver, biliary ducts and gall-bladder. Owing to the chances of contamination by the

* See Tables A and B, page 366.

presence of large numbers of various bacteria to be found in the mouth under average conditions, also of the varying kinds and numbers present in the stomach according to the condition of this organ and the cycle of its physiological activities, it is logical to view with considerable skepticism the results of bacteriological examinations of bile secured by duodeno-biliary drainage. I must confess that I shared this skepticism in generous degree but have gradually become convinced that with strict attention to details in the method of collection, bile may be obtained in the majority of instances free of contamination with bacteria from the tract extending from the lips to the pylorus at least. Whether or not contamination occurs with bacteria from the duodenal mucosa and pancreatic secretions is difficult to answer. During fasting, however, the numbers of bacteria on the normal duodenal mucosa are very small and cultures made during surgical operations are frequently sterile. In duodenitis of bacterial origin the flora is obviously increased and especially if there is an associated infection of the gall-bladder and biliary ducts, but if the first flow of duodenal contents is discharged and the practically pure bile selected for study, I believe that the results of properly conducted bacteriological examinations are reliable and acceptable in the majority of cases for showing the kind or kinds of bacteria actually present in the bile. This is especially true if the bile is examined at once by direct microscopical examination, because time is not permitted for the extensive proliferation of contaminating bacteria, as will be shortly discussed in more detail.

It must be emphasized, however, that the risks of contamination are only controlled by the closest attention to details in the method of drainage. For example if the tube happens to be in the stomach instead of the duodenum when suction is made and gastric contents are aspirated, the results are questionable because the tube may become contaminated. But in those instances in which the tube passes into the duodenum the factor of accidental contamination is well controlled.

The approximately 33½ per cent solution of magnesium sulphate injected into the duodenum is not a source of contamination. Experiments have shown that a solution of this strength is usually sterile and while lacking in bactericidal activity for such micro-organisms as streptococci, staphylococci and bacilli of the colon group, it is not itself a source of bacterial contamination under usual conditions and doubtless tends to reduce contamination in the duodenum by partial washing of the mucosa.

Experience has shown that more than ordinary care and attention must be given the subject of bacteriological technic, with special reference to the choice of culture media; for this reason the methods

which we have found satisfactory for these examinations are described in this chapter with considerable detail, without, however, including complete descriptions of the various bacteria found, since data of this kind are available in systematic text-books on bacteriology.

Even under rigid and acceptable technical conditions however, it may be possible to secure bacteria in cultures of apparently healthy bile from the normal liver and biliary passages. It is commonly stated that these bacteria, and especially the colon bacillus, gain access to the portal blood followed by excretion in the bile without producing disease. This so-called *subinfection* is largely based upon the results of bacteriological studies of the bile and liver after death, but not always immediately after death in order to avoid the error of agonal or postmortem bacterial invasion of the tissues. The frequency with which sterile bile is secured during life by duodenal-biliary drainage has reduced the incidence and importance of this condition of *subinfection* or bacterial excretion by the normal liver and biliary passages. Furthermore the frequency with which closer study of so-called "normal" individuals has shown the presence of pathological changes in these tissues and organs, has demonstrated the necessity of preserving an open mind on this question until data of a more reliable and accurate nature are available.

Smear Versus Cultural Examinations.—For the bacteriological examination of bile two methods should be employed: (a) Direct microscopical examination of unstained or stained specimens and (b) cultural examination.

Direct Microscopical Examination.—Direct microscopical examination shows the bacterial content of the bile at the time of its withdrawal; even though contamination occurred during drainage the number of extraneous bacteria gaining access to the specimens of bile under the conditions of the method of drainage are so few as not to be disturbing since sufficient time for multiplication into large numbers is not given. Valuable information is gained regarding the numbers of bacteria and whether or not they are occurring in clumps or colonies; furthermore a good idea is obtained regarding the kinds of bacteria present as clumps of cocci (usually staphylococci), chains of cocci (usually streptococci), Gram-positive and negative bacilli, yeast, etc. *Not infrequently the streptococci are of such low vitality or present in such few numbers that they may not survive or proliferate in culture media, and for this reason culture methods alone may not yield complete or sufficient bacteriological data.*

Cultural Methods.—Cultural methods, however, are required for the identification of some of the bacteria present and the preparation of autogenous vaccines; in so far as the viable micro-

organisms are concerned, they may be made quantitative and to some extent a measure of the degree of bacterial infection. When these methods are employed, however, the collection of bile must be made with great care in order to guard against contamination.

The two methods therefore, possess certain advantages and *both should be employed whenever possible*. Since proliferation of some bacteria may occur after removal of bile (notably staphylococci and bacilli of the colon group), while others may gradually die off (particularly streptococci), *it is advisable to conduct these examinations as soon as possible after withdrawal of the specimens*. Broth cultures are made at once during the actual drainage, but specimens collected in sterile containers for plating and smears should be examined within a few hours of collection.

Technic of Direct or Smear Examination.—Unstained.—At the time direct examinations are made of flocculi of mucus, pus or of sediment for the various kinds of cells, crystals, etc., that may be present as described in the preceding chapter, some idea may be obtained regarding the bacterial flora.

For this purpose a small drop or several loopfuls of the selected material are placed on a slide and covered with a thin cover glass. The material is then pressed into a thin layer by gentle pressure and the preparation examined by means of the oil immersion lens with the light well cut off. By this means staphylococci (usually occurring as diplococci), streptococci and various bacilli may be seen and their numbers roughly estimated and particularly whether or not they are occurring in clumps or colonies.

Stained.—Stained preparations are much better for a study of this bacterial flora. Smears of the selected material are made on microscopical slides in much the same manner as preparations of sputum for examination for tubercle bacilli. These smears are well made by means of the usual platinum loop but a drop of material may be deposited upon a slide from a pipette and subsequently drawn out into a thin smear by means of a slide, glass rod, wire, etc. It is necessary to avoid thick smears because they dry very slowly, tend to peel off during the staining process and thick masses are unfit for bacteriological examination.

After staining, the slide is washed with water, carefully dried and examined with the oil immersion lens.

Technic of Cultural Examination.—Broth Cultures.—The *special culture flask* employed has been previously mentioned. It is well adapted for the collection of bile during the process of drainage with least chances of contamination. As devised by Dr. Russell Richardson, this culture flask consists of an ordinary 150 cc

Ehrlenmeyer flask fitted with a No. 3 two-holed rubber stopper. Two pieces of soft glass tubing are bent in a fan tailed burner and fitted into the stopper, Fig. 131, page 350, showing the details. The two open or outside ends of the tubing are plugged with cotton, the flask sterilized by autoclaving, charged with 100 cc of the special broth and the latter sterilized in the flask as described below. After the last sterilization the ends of the tubing may be paraffined to prevent evaporation and it is well to fasten in the rubber stopper with wire to prevent accidental contamination of the medium.

The *choice of medium* is a factor of considerable importance. The broth should be favorable for the growth of the less hardy microorganisms and particularly the various types of streptococci; this is especially true since these bacteria may be of low vitality and indeed, many of them may be dead in the small amount of bile employed for the culture. Not infrequently smears of the bile show the presence of cocci failing to grow in the culture medium, even though the latter is known on the basis of preliminary tests to be satisfactory for the cultivation of streptococci.

The ordinary plain broths enriched with sterile serum and ascites fluid and with or without dextrose, may be employed with success providing they are known beforehand to successfully cultivate streptococci. In order to avoid the use of serum, ascites fluid, blood, etc., which increase the chances for bacterial contamination, I have employed Huntoon's (1) hormone gelatin broth with success. This medium is now prepared as follows:

(a) 500 gm. of minced *fresh* beef heart are placed in 1000 cc of water and heated with constant stirring until the temperature reaches 58 to 60° C. At this point the meat suddenly disintegrates and the mixture becomes much easier to stir. The flame should be turned off and the mixture stirred for five minutes. Now add:

Peptone	10 grams
Salt	5 grams
Gelatin	10 grams
One egg, shell included, slightly beaten.	

(b) Heat the mixture to 68° C. or until the meat turns brown. Heat over open gas stove or water-bath; if over open flame constantly stir, using agateware long spoon. Titrate roughly against litmus paper and render amphoteric.

(c) Place in Arnold sterilizer for one hour from boiling-point.

(d) With glass rod, carefully remove clots from side of container.

(e) Replace in the Arnold for one and a half hours or until broth separates and the coagulum sinks to the bottom of the container. Strain off meat by means of a fine wire sieve.

(f) Titrate to 0.5 plus using phenolphthalein, then add 0.1 per cent glucose.

(g) After adding the required normal sodium hydrate, replace the container in the Arnold for twenty minutes to throw down the phosphates.

(h) When entirely cold, fat and phosphates may be removed by means of a filter made of glass wool and asbestos wool. If the broth is filtered while hot the fat may be removed by means of a separatory funnel. As a general rule if fresh beef is used filtration is not necessary as the clear broth can be syphoned off comparatively free from the precipitate. When large quantities are being made, it is easier to clear the medium with the Sharpless centrifuge.

(i) The broth must not come in contact with any vegetable fiber.

(j) The sterilization is important and may be done with the Arnold sterilizer. If the broth is in tubes the sterilization should be for thirty minutes after boiling begins, for three successive days. If larger containers are used the time must be longer in proportion. After the last sterilization, the broth is held under observation for five days for sterility before use. While formerly it was believed that heating above 100° C. was injurious it is now known that the medium may be sterilized without injury by autoclaving for fifteen minutes at 12-pounds pressure.

(k) Each batch of media is tested with a culture of streptococcus and pneumococcus and *rejected* unless luxuriant growths are obtained in eighteen hours.

The Ehrlenmeyer flasks are of 150 cc capacity; approximately 100 cc of this broth are placed in each.

The *amount of bile* to place in a flask is a matter of considerable importance. When the bile is heavily infected a few drops may suffice but when lightly infected and especially if streptococci are known to be present from the smears or their presence suspected, larger amounts should be employed. For routine work 20 drops have been usually added to a flask; with bile of ordinary consistency this amounts to a little more than 2 cc with the glass tubing employed. Whenever possible this amount should be the minimum and in view of this high dilution in the broth several times this volume of bile may be employed and especially if but relatively few bacteria are suspected as present. Normal bile is known to possess a slight degree of antiseptic activity but such microorganisms as staphylococci, colon and typhoid bacilli and other bacilli of the group survive and proliferate in undiluted normal bile. Streptococci also survive but normal bile is destructive for pneumococci. Bile containing many epithelial cells, pus and mucus with probable changes in the bile salts as a result of disease, is even more favorable as a medium for bacterial proliferation and for

these reasons *one need not hesitate to culture relatively large amounts*. For example, at least 10 to 20 cc of bile may be added to 100 cc of broth without danger of rendering the latter antiseptic or reducing greatly its cultural properties. Of course care must be exercised against draining the magnesium sulphate solution into the flask of nutrient broth but here again the danger of adding sufficient magnesium sulphate to induce a state of bacteriostasis is very slight.

The subsequent steps are as follows:

1. The culture is incubated at 37° C. for twenty-four hours. If the broth has become distinctly cloudy a growth of bacteria has probably taken place. In some instances, however, *clouding is due to the presence of mucus and pus or precipitation of bile salts and not to bacteria*. Sometimes the broth remains perfectly clear but a sediment gathers in the bottom of the flask, which when shaken, gives the broth a cloudy appearance. In such instances streptococci may be found, but as a general rule, when bacteria are present, the broth becomes diffusely cloudy and the sediment at the end of twenty-four hours is due to mucus, bile salts or phosphates from the culture medium.

2. If the broth has become cloudy at the end of twenty-four hours it is examined; if it has remained clear incubation is continued for another day or two.

The flask is carefully opened to avoid contamination and smears made of the broth. These are stained (one being stained by the method of Gram) and carefully examined. A hanging drop may be examined.

If these examinations disclose the presence of apparently a pure culture of some microorganism, several loopfuls are transferred to a slant of some solid culture medium. For this purpose blood agar is required for streptococci and pneumococci to determine whether or not the streptococci are hemolytic or green pigment (*viridans*) producers. For this purpose I generally employ an agar prepared of the hormone broth described above with about 1 cc of sterile defibrinated human, horse or rabbit blood for each 9 cc of the medium. Otherwise Löffler's blood serum medium plain or glucose neutral agar may be employed for staphylococci and various bacilli. It is my practice to use two or three slants of blood agar routinely in order to secure as quickly as possible luxuriant growths for the preparation of vaccines.

If more than one organism is present the broth culture must be plated according to usual bacteriological methods. I employ Petri dishes of blood agar if streptococci and pneumococci are present; if streptococci and pneumococci are not present, neutral plain or glucose agar plates are employed. It is my custom to use the surface streak method entirely in order that the colonies may be

on the surface. After twenty-four to forty-eight hours' incubation a number of colonies are examined by smear and transferred to slants of a solid medium.

Subsequent identification is made according to usual bacteriological methods:

(a) *Streptococci* are readily identified by their morphology and the appearance of the colonies on tubes or plates of blood agar. They are divided into non-hemolytic, hemolytic and green pigment producing varieties (viridans) according to their behavior on blood agar. Too much emphasis, however, should not be placed upon the practical importance and significance of this classification because this property of streptococci is subject to modification and variation by the culture medium employed. If *pneumococci* rather than streptococci are suspected, differentiation is made largely on the basis of acid production by pneumococci in Hiss serum water glucose medium, the greater virulence of pneumococci for mice, the solubility of pneumococci in normal bile and by the agglutination test employing Type I, II and III antipneumococcus sera. As a matter of experience pneumococci are only rarely found in cultures of bile and when they do occur, it is apparent that the bile is lacking in the pneumococidal and dissolving substances found in normal bile.

(b) *Staphylococci* are readily identified. In smears of the broth culture they may occur as diplococci, but on solid media the typical clump arrangement is usually apparent. Differentiation between *S. albus* and *S. aureus* is made by the color of the colonies, the rapidity of coagulation of milk and liquefaction of gelatin. Rapid differentiation is sometimes possible by the agglutination test employing polyvalent *albus* and *aureus* rabbit immune sera.

(c) The *bacilli* usually belong to the *typhoid colon group*. They are identified by being slightly motile, Gram-negative and yielding characteristic fermentation reactions. Tests for indol production, coagulation of milk, liquefaction of gelatin and such ordinary methods may be employed. Agglutination tests are required for the identification of the typhoid bacillus. I have found Russel's double sugar medium particularly useful for purposes of identification of bacilli of this group.

Diphtheroid bacilli are sometimes found but are readily identified by morphology and grouping in smears stained by the method of Gram. *B. subtilis* is frequently found being the commonest organism producing contamination. It is readily recognized by the scum produced on the surface of the broth culture, morphology, spore production, rapid liquefaction of Löffler's serum medium, etc. *B. pyocyaneus* is readily recognized by its morphology, reaction to the Gram stain, production of pigments, liquefaction of gelatin, etc.

3. If the primary broth culture remains clear for seventy-two hours it is usually sterile, but sometimes subcultures yield a growth of bacteria. Smears of clear broth do not disclose bacteria but subcultures may do so, as just stated. One naturally suspects that the subculture is contaminated but this has occurred frequently enough under well controlled conditions to render advisable the very careful routine subculturing of all such cultures, blood agar being the medium of choice. Apparently some batches of the hormone broth may not be as favorable for bacterial growth as others and the organisms do not proliferate with sufficient rapidity although they are not destroyed by the medium within seventy-two hours and grow when subcultured.

The subculture is examined after twenty-four hours' incubation and if a growth has not occurred, the bile culture may be regarded as sterile.

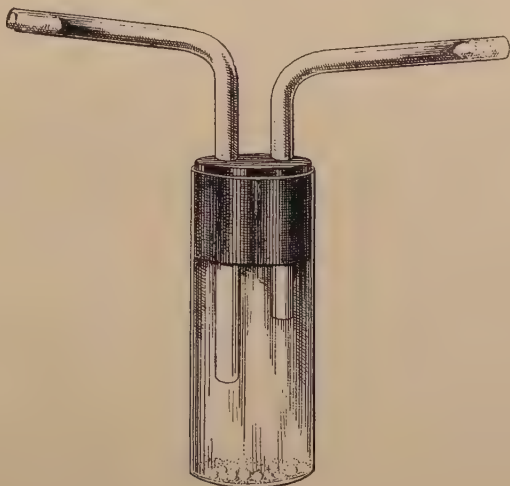


FIG. 134.—Represents collection flask for the securing of bile for a roughly quantitative cultural determination by the plating method.

Plating Methods.—The broth culture method described above is only roughly quantitative, that is, if a heavy growth of a particular organism occurs within a few hours it is reasonable to assume that it is present in the bile in large numbers. More accurate data regarding the numbers of bacteria present per unit volume of bile are obtained by plating the bile in a solid medium as soon as possible after the specimen has been received.

For this purpose the collection flask shown in Fig. 134 has been found satisfactory. It consists of a glass vial fitted with a two-holed No. 4 rubber stopper and two pieces of bent glass tubing

similar to the arrangement of the broth culture flask. Glass beads are placed in each vial and the whole sterilized by autoclaving. Bile is collected by means of one tube while suction may be made with the second. When received in the laboratory plates are immediately prepared; if a delay is unavoidable the vial is placed in a refrigerator.

(a) Hormone agar is employed. This medium is prepared of the same broth as described above and tubed in amounts of 10 cc followed by sterilization. For each specimen of bile three tubes are boiled until the medium is fluid followed by cooling to 45° C.

(b) The vial is well shaken in order to break up to some extent at least the clumps of bacteria. For this purpose the vial should be shaken at least twenty-five times.

(c) Three sterile Petri dishes are arranged and charged with 1, 0.1 and 0.01 cc (0.1 cc of a 1 to 10 dilution in sterile saline or broth) of the bile, a sterile 1 cc pipette being employed.

(d) A tube of the agar medium is then added to each plate and thoroughly mixed.

(e) After hardening the plates are turned upside down and incubated for twenty-four to forty-eight hours when the colonies are counted and the total number per cc of bile estimated.

(f) From 10 to 25 colonies are then examined to order to express the approximate percentage of each organism in case two or more are present.

(g) Colonies are removed to slants of solid media for the purpose of identification along the lines described above.

Comparative Value of the Broth and Plating Methods.—A comparative study of 97 specimens of bile secured by duodeno-biliary drainage from Dr. Lyon's clinic, examined by both methods at the same time with the assistance of Dr. Malcolm Harkins, have shown that the broth method is slightly superior for the cultivation of streptococci. With the other microorganisms commonly encountered as the various types of staphylococci, colon bacilli, *B. lactis aërogenes*, *B. fecalis alkaligenes*, diphtheroids, etc., little or no differences were demonstrable. The broth method is also more simple, less time consuming and *less subject to contamination* and is the method of choice for the routine examination of bile secured by duodeno-biliary drainage.

The most important single advantage of the plating method is the information it yields on the approximate numbers of bacteria per cc of bile. The importance of this information, however, should not be overemphasized because the counts are only approximately correct inasmuch as it is very difficult to thoroughly break up the clumps before plating and especially chains of streptococci. For this reason the counts are usually too low and in routine work the

information gained is hardly worth the considerable extra time and labor involved.

As will be discussed shortly, it is sometimes difficult to properly evaluate the bacteriological findings and especially since it is commonly believed that colon bacilli may be eliminated in the bile of the healthy normal liver. It is possible that plating methods may establish quantitatively the number of colon bacilli to allow as "normal" but this does not appear possible at present with our data inasmuch as the number of bacteria per cc of bile from cases with obvious infection of the gall-bladder and biliary passages have varied from as few as 6 to as many as 11,000. As a general rule "A" and "B" biles have contained more bacteria than "C" bile, but exceptions have occurred as shown in the following table of comparative counts taken at random from a series of cases:

Case.	Microorganism.	Number in A bile.	Number in B bile.	Number in C bile.
No. 1	Staphylococcus albus	24	18	12
No. 2	Staphylococcus aureus	1000	78	25
No. 3	Staphylococcus aureus	304	182	10
No. 4	Non hem. streptococci	1600	1040	6400
No. 5	Staphylococcus albus	32	22	340
No. 6	Hemo. streptococcus	76	20	5
No. 7	B. coli (communior)	110	120	8

Virulence and Immunological Reactions of Bacteria Secured in Cultures of Bile.—As previously discussed it is obvious that two sources of error are possible in evaluating the significance of bacteria in the bile secured by duodeno-biliary drainage, namely, the possibility of bacterial contamination, and that bacteria may be eliminated in the bile without disease of the liver, gall-bladder and biliary passages.

Contamination may occur in the mouth and stomach and to a lesser extent in the duodenum, but with the extraordinary precautions observed in Dr. Lyon's method of drainage and culturing, these chances are reduced to a minimum. Regarding the elimination of the colon bacillus and other bacteria in normal healthy bile, I am of the opinion that the importance of this commonly accepted teaching is overemphasized. There is lacking sufficient data on bacteriological studies of normal healthy bile in human beings collected during life; almost without exception such examinations have been made after death when postmortem bacterial invasion and especially of the abdominal organs with the colon bacillus is known to occur rapidly and extensively. Careful

studies of the biles of large numbers of rabbits, guinea-pigs and cattle made immediately after death have shown that the bile is almost invariably sterile. It is to be granted that the chances are good for bacterial invasion of the portal blood with the colon bacillus and other intestinal microorganisms followed by filtration in the liver and elimination in the bile, but it is very difficult to eliminate the possibility of disease of the liver and biliary passages as being primarily responsible for the presence of bacteria in the bile when the latter is collected during life.

In so far as the results of bacteriological studies of bile secured by duodeno-biliary drainage are concerned, streptococci, staphylococci and colon bacilli are most commonly encountered. With the assistance of Dr. Harkins, a number of each of these from different cases have been injected intravenously in rabbits. In the majority of instances the streptococci have proven virulent and the injections were followed by death in forty-eight to ninety-six hours with the presence of streptococci in the blood, gall-bladder bile and in some instances, in the walls of the gall-bladders. Of even more significance were the results observed following the intravenous injection of the colon bacilli which were frequently followed by death, positive blood and bile cultures and the presence of bacilli in the mucosa and deeper layers of the gall-bladder. Staphylococci of the aureus variety were occasionally virulent for rabbits when injected in large doses, but blood and bile cultures were usually sterile and cocci have never been found in the walls of the gall-bladders. Staphylococci of the albus variety were always found to be non-virulent for rabbits.

Of course, too much emphasis cannot be placed upon the significance of positive cultures of the bile and the presence of bacteria in the gall-bladder walls following the intravenous injection of rabbits with streptococci and colon bacilli from human cases of hepatic and biliary passage disease. The natural assumption is that such findings are an expression of selective localization of the bacteria in these tissues, but the intravenous injection of similar organisms from other sources may be followed by similar results. Indeed, the frequency with which this occurs in the rabbit suggests that bacterial invasion and infection of the bile and gall-bladder in the rabbit following intravenous injection of various bacteria, is of rather common occurrence as shown by A. O. J. Kelly (2) many years ago. On the other hand the frequency with which the various bacteria are found to be virulent with localization in the gall-bladder and bile indicates their etiological relationship to inflammatory processes in the liver and biliary passages.

Further evidence of the etiological relationship of these bacteria to diseases of the liver, gall-bladder and biliary passages was sought by immunological investigations consisting in a study of the serum

of each of a number of patients for agglutinins, opsonins and complement-fixing antibodies for the bacteria recovered in cultures of their bile. Unfortunately evidence of this kind has a positive value only, that is, if one or more of these antibodies are found to be increased it is logical to assume that the bacteria were virulent and sufficiently active to bring about an immunity response. On the other hand failure to demonstrate an increase of antibodies in the serum for a particular bacterium does not imply that the latter is saprophytic and harmless, as it is well known that the value of serum reactions as an index of resistance and immunity is sharply limited.

With the streptococci and staphylococci of the aureus variety, the phagocytic and opsonic indices of the sera of a number of patients were either so low or sufficiently increased as to leave little doubt concerning their pathogenic significance. With staphylococci of the albus variety the indices were generally the same as observed with control sera or the differences within the scope of technical error. Agglutination and complement-fixation tests with the streptococci and staphylococci were always negative, but it is well known that agglutinin production does not occur at all or but to a very limited degree, in streptococcus and staphylococcus infections.

With the colon bacilli, the phagocytic and opsonic indices likewise indicated, in some cases at least, the etiological relationship of the organisms. In a few instances the agglutinins and complement-fixing antibodies were likewise increased above the normal. In the tables the results of some of these experiments are summarized. The practical value of virulence and serological tests of this kind as a means for determining which bacteria recovered in cultures of bile are important etiologically and which are not, and especially in relation to the question of preparation of vaccines, is limited by reason of the fact previously stated that an absence of positive results is not reliable evidence of lack of etiological importance. Positive results however, indicate quite clearly the pathogenicity and etiological importance of the bacteria found in cultures, providing vaccines of the organism have not been previously administered, and one general result of our studies along these lines has been to show that in many instances the streptococci, colon bacilli and staphylococci of the aureus variety recovered in cultures of the bile secured by duodeno-biliary drainage possess some degree of enhanced virulence and are of etiological significance.

Tables A and B present the findings of 64 cases studied in this manner.

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TABLE A.

Case.	Clinical diagnosis.	Plate cultures.				Broth culture.			Immunological.			Virulence for rabbits (intravenous injection)
		Bile A.	Bile B.	Bile C.	Bile A.	Bile B.	Bile C.	Opsonic index.	Agglut.	Comple- ment- fixation.		
J. M. A. F. H. L. W. M. W. B.	Chronic appendicitis; chronic cholecystodochitis Chronic cholecystitis. potential calculi; bil- iary migraine Gastroduodenitis masked infection of gall-tract with atony of gall blad- der; hepatic-intestinal toxemia	Staph. alb. (24)† B. coli (56)† Staph. (192)†	Staph. alb. (18)† B. coli (78)†	Strept. (12)† Sterile	0* 0 0	Staph. aur. B. coli Staph. aur.	Strept. 0 Staph. aur.	S. aur. 1.9 Strept. 1.8 B. coli 0.9 Staph. 0.4 1.7	0 Negative Negative Negative	0 Negative Negative Negative	Staph. not virulent Strept. Virulent.† B. coli Not virulent Staph. Not virulent. Virulent.	
D. J. C.	Hepatic-intestinal tox- emia; "masked," infec- tion of gall-tract	B. coli (thousands)	B. coli; staph. (thousands)	B. coli (thousands)	0	B. coli staph.	0	B. coli 0.3	Negative	Negative	B. coli. Virulent.†	
M. J. R.	Cholelithiasis with pos- toperative cholangitis and obstructive jaun- dice due to common duct stone apparently missed at first opera- tion	0	0	B. coli (thousands)	0	0	B. coli	0.4	Negative	Positive	Virulent.†	
W. P. G.	Chronic atrophic gastrit- is; chronic enterocoli- tis (spastic); "masked" infection of gall-tract	0	0	Staph. aur. B. coli (5200)†	0	0	Staph. aur. B. coli	Staph. 1.2 B. coli 0.8	0	0	Staph. aur. tested. Virulent.†	
H. M. S.	Visceropostitis; hepatic intestinal toxemia, "masked" infection of gall-tract with sus- pected cystic duct ob- struction	0	B. coli (thousands)	B. coli staph. (3760)†	0	0	Strept. staph.; B. coli	0	Negative	Negative	B. coli tested. Viru- lent.†.	
R. K. E. P. D.	Atrophic gastritis Cholecystitis; probably cholelithiasis (histori- cal evidence only); ad- hesions, upper right quadrant	0 Staph. aur. (4960)†	B. coli; staph. (thousands) 0	0 0	0 0	B. coli staph. 0	0 Staph. aur.	B. coli 0.9 Staph. 1.6 0.7	Negative 0	Positive 0	B. coli tested. Viru- lent.† Virulent.†	
L. A. C.	Congenital visceropostitis; "masked" infection of gall-tract; probably cholecystitis, low grade	0	Staph. aur. (160)†	Staph. aur. (84)†	0	Staph. aur.	0	1.3	0	0	Virulent.†	
E. R. W.	Chronic cholecystitis	0	Staph. aur. (3120)†	Staph. aur. (90)† 0	0	Staph. aur.	0	2.2	0	0	Virulent.†	
M. A. H.	Hepatic intestinal tox- emia; chronic cholecys- todochitis	0	B. coli (118)†	0	0	B. coli	0	1.2	0	0	Virulent.†	

0* = examination not made.

† = Number per cc of bile.

† = Organisms present in tissues of gall-bladder.

CHAPTER XX.

ROENTGEN-RAY DIAGNOSIS OF GALL-BLADDER DISEASE.

BY WILLIS F. MANGES, M.D.

THE roentgen-ray diagnosis of gall-bladder disease is becoming more and more reliable in the hands of those roentgenologists who have given attention to the details of roentgenography and roentgenoscopy necessary to elicit definite diagnostic signs; and especially those who have studied carefully the excellent work done by the pioneers in this field: Pfahler, (10) Case, (3) Cole, (4) George, (6) Roberts (11) and Stewart. (12) Others have reported instances of finding gall stones but these men have done the real constructive work in this country. They deserve the more credit because the preconceived ideas of many surgeons and internists, as well as some roentgenologists, that only a small percentage of gall stones are dense enough to cast positive shadows, on the one hand, and that gall-bladder disease is readily diagnosed clinically, on the other hand, have served to limit the efforts of roentgenologists.

Both of these ideas should be discarded. It is entirely safe to say that positive shadows of gall stones can be demonstrated in at least 50 per cent of the cases. Then there is an increasing percentage of cases in which the diseased, distended gall-bladder is shown in positive shadow, and, also, with more frequency and accuracy, disease of the gall-bladder is being shown by the effect of adhesions to adjacent organs, such as the duodenum, stomach and colon, as well as functional disturbance of these organs. If one resorts to the procedure of pneumoperitoneum, a much larger percentage of stone cases become positive and other evidence of pathology is more readily seen.

A diagnosis of gall-bladder disease without detection of stones that may be present is almost as valuable as one that clearly presents evidence of stones, for it is being more generally accepted that any definite state of disease in the gall-bladder constitutes a real menace to the patient and should, if possible, be removed, or, at least, any other treatment should accomplish removal of all evidence of disease before releasing the patient. The idea, then, that only a small percentage of gall stones cast positive shadows must be withdrawn, as it is only partly true, and is misleading.

The other idea that gall-bladder disease is easily diagnosed clinically is gradually disappearing without protest, and the best evidence of this contention is the wide recognition of the excellent work of Dr. Lyon, his collaborators and contemporaries, in the study of gall-bladder disease by means of intraduodenal gall-tract drainage.

Then, too, the rather large number of gall stones and diseases of the bile passages found at autopsy or by exploratory operation tend to disclaim the validity of the idea that gall-bladder disease is easily

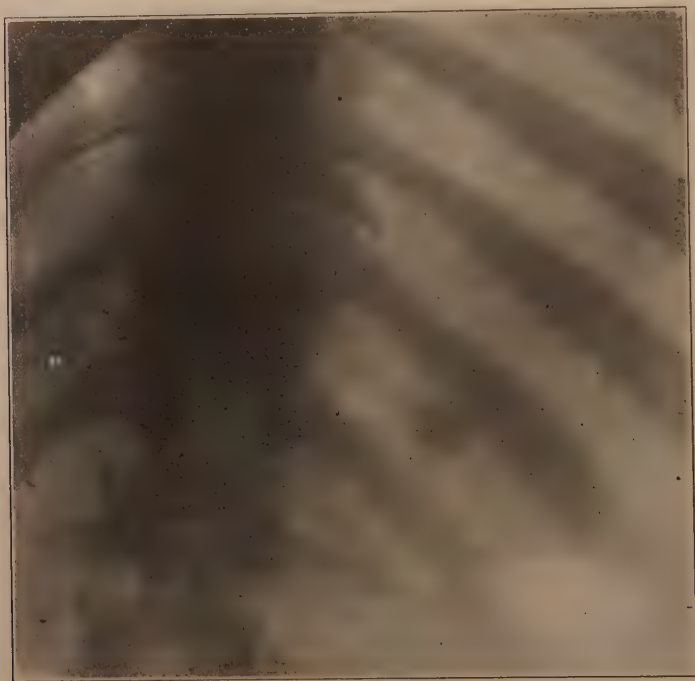


FIG. 135

diagnosed clinically. We have frequently found gall stones or other evidence of gall-bladder disease in patients sent to us for gastro-intestinal study, and occasionally have found gall stones to be responsible for symptoms that have pointed strongly to kidney stones. In one case, Fig. 135, the clinical picture was so strongly in favor of kidney lesion that the surgeon actually delivered the right kidney and searched it most carefully for the stone, even though the roentgen-ray diagnosis was gall stones. When he did not find the stone in the kidney, he made an opening through the peritoneum and then felt the stone in the gall-bladder. The

patient was a young man, aged eighteen years. The stone was exceedingly dense for a gall stone.

Another unusual situation was present in a patient who had a hard movable mass in the right abdomen. It corresponded somewhat in size, shape, and hardness with a floating kidney, could be displaced from the front to the back on bimanual palpation, and,



FIG. 136

in fact, was so dense that its shadow could be seen clearly on the fluoroscope. Differential diagnosis was made by injecting the right kidney pelvis with thorium solution, and then demonstrating fluoroscopically that the movable mass could be displaced without changing the position of the kidney. Fig. 136 shows the shadows of the ends of the calices extending beyond the edge of the shadow

of the movable mass. We expressed the opinion that it was a pathological gall-bladder, and this was confirmed by operation.

On another occasion we were called upon to differentiate, by means of the roentgen rays, between empyema of the gall-bladder and acute suppurative appendicitis. The roentgen-ray evidence was quite clear that the infection was in the gall-bladder. Adhesions to the duodenum and colon were present, and so extensive that the surgeon was unable to remove the gall-bladder, even though it was almost gangrenous. A large number of stones were present, and yet the previous history failed to indicate a disease of the gall-bladder, which would have helped to make the diagnosis of the acute lesion. The patient was a nurse on duty in the hospital at the time of onset of the acute illness. It is interesting to note that the stones in this case cast negative shadows and looked more or less like small collections of gas. The roentgen-ray diagnosis was not made from these shadows but it was entirely clear at the fluoroscope, with a small quantity of barium mixture in the stomach that the duodenum was drawn far to the right and firmly attached to the gall-bladder mass in the right hypochondrium nearer to the lateral abdominal wall than to the median line. The cecum was filled with gas and entirely free from the inflammatory mass. On manipulation it was evident that the appendix could not be the cause of the trouble. (See stones casting negative shadows. Figs. 154 and 155; page 388.)

Not uncommonly gall-bladder disease is present in association with other abdominal lesions. Duodenal ulcer, cholecystitis and appendicitis are more than occasionally present in the same patient. In a study just concluded, we found definite evidence of cholecystitis, a fairly large diverticulum of the third portion of the duodenum, and the cecum quite tender at the point where the appendix should be. This was looked upon as being due to an inflamed appendix, since the tenderness was very much localized, although the appendix was not visualized. (See Fig. 137.)

In another recent case, we found a stone in the pelvis of the left kidney, which was suspected clinically, and also found a diseased gall-bladder containing six or more dense stones, which was not suspected. (See Fig. 138.)

Then there is a group of potential gall-bladder cases which do not lend themselves to duodenal drainage, viz.: Those that have a degree of pyloric or duodenal obstruction sufficient to prevent passage of the tube. It may be difficult to demonstrate the exact nature of the lesion, even with the roentgen-ray method, but as a rule very valuable information is gained, usually the cause of the obstruction is shown, and the question as to prognosis is made more clear. Fig. 139 is of a patient who had almost complete obstruction

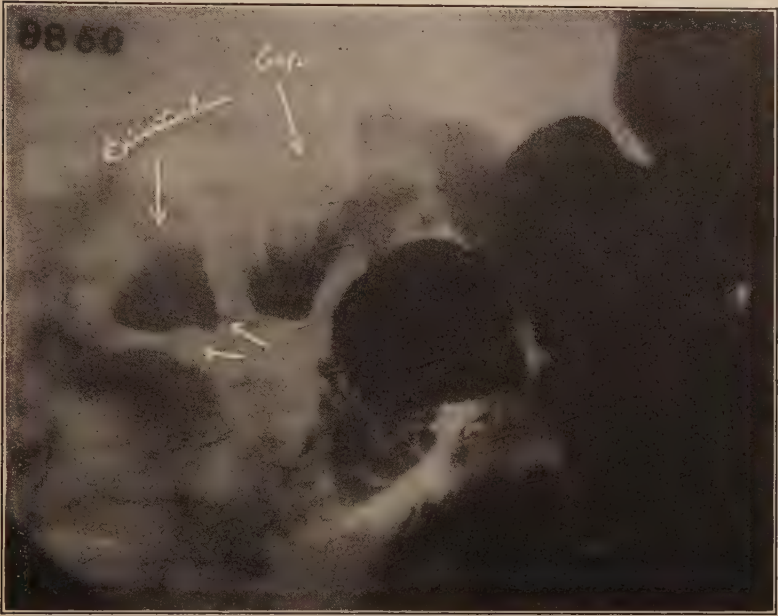


FIG. 137



FIG. 138

at the pylorus, due to adhesions of gall-bladder origin. The roentgen-ray diagnosis was pyloric obstruction due probably to cicatrization from a pyloric or duodenal ulcer. At operation no ulcer was found. The stomach was greatly dilated and there was almost complete retention of the barium in the stomach at twenty-four hours. If the obstruction had not been so marked, it probably would have been possible to demonstrate the effect of the adhesions on the duodenum. Loss of weight was manifestly due



FIG. 139

to the obstruction and not to malignancy. The prognosis was clearly favorable with a gastro-enterostomy.

Obstruction of the common duct or more frequently of the cystic duct may interfere with diagnosis by drainage.* In obstruction of the common duct, the clinical picture may be clear, but frequently is not. In obstruction of the cystic duct alone, the clinical picture is more often indefinite than clear. In both of these conditions, distention and dilatation of the gall-bladder is a frequent result, or if stones are present or disease of the walls cause fibrous

* See page 331 and Report of Case No. XXV.

tissue formation the gall-bladder may be smaller and far more dense than normal. These are conditions frequently recognizable by roentgen-ray methods.

It is common practice to make a clinical diagnosis by a process of exclusion, and the roentgenologist who pays proper attention to history, symptoms, and physical signs may justly resort to this process. The method is certainly of advantage in ruling out lesions of those organs that may be involved in the symptom complex, such as the stomach, duodenum, appendix, colon, and kidney, and, at times, the pancreas.

The size and weight of the patient have an important bearing on the results of roentgen-ray study. In the large-bodied, solid-tissued individual, only the fairly dense stones can be shown. In patients weighing more than 160 pounds, the average pathological gall-bladder, depending for its shadow-casting qualities on thickened walls and inspissated contents, can only be shown on plates or films of the most excellent detail and maximum contrast. At present such results are not uniformly attainable. It is also increasingly difficult, the stouter the patient, to determine with any degree of accuracy the presence of small adhesions. In short, in very large patients, the roentgen-ray examination is of very little value in making a negative diagnosis, and a positive diagnosis depends upon the presence of dense stones, a very dense gall-bladder, or extensive adhesions. However, practically all of these difficulties can be overcome by resorting to pneumoperitoneum.

The study of the gall-bladder is a far more complex matter than an examination for urinary stone, not alone because nearly all urinary stones are dense while many gall stones are not, but further because the kidney outline is always recognized, whereas the normal gall-bladder probably never produces a recognizable shadow, and sometimes an extensively diseased gall-bladder does not. It may be distorted or hidden in an irregular mass of inflammatory adhesions, or even by intestinal contents, either solid, liquid, or gaseous. A negative diagnosis cannot be made with any degree of certainty by means of roentgenograms made routinely for detection of gall stones. Each case should be considered an individual problem to be studied from as many different angles as possible. In fact, any gall-bladder study should include a complete abdominal examination, for the reason we have before mentioned that multiple lesions are frequently associated or the lesion producing the symptoms may be elsewhere in the abdomen.

Gall stones from the roentgenographic point of view may be classified broadly as follows:

1. Single dense stone casting uniformly dense shadow.

2. Multiple, fairly dense stones which, by their size, shape, position and arrangement warrant easy positive diagnosis.
3. Collection of dense sand giving quite positive shadow.
4. Stones, frequently single, which contain only thin surface deposits of material dense enough to cast positive shadows.
5. Stones, usually multiple, which are definitely less dense than surrounding structures and which cast so-called "negative shadows."
6. Stones, usually multiple, which do not cast distinguishable shadows.



FIG. 140

This classification does not take into account the chemical nature of the stones except by inference that the denser ones contain a definite amount of calcium and the heavier bile pigments, and that those less dense do not contain these elements in excess. It frequently happens that there is a great variety as to composition, as well as size, in the same patient, and we feel that it is unnecessary, perhaps futile, to attempt to determine the chemical nature of stones roentgenographically. One might almost as well attempt to tell the color. From the viewpoint of pathology, one kind of stone is just as important as another. They all indicate infection, and are therefore a menace to the patient.

The size of the stones may be a matter of importance, for those small enough to pass into the common duct present prospects of recurrent gall-stone colic, although very small stones may be held fast in the cystic duct, and large stones are found at times in the common duct. Fig. 140 shows a small stone in the cystic duct and numerous smaller stones in the gall-bladder. It is interesting to note that this patient's symptoms pointed more to renal calculus than to gall stones. Any extended effort to classify gall stones as to size is also impracticable, for often there are stones of wide variation in size in the same case and one or the other may not cast a shadow; and further, in the case of stones casting negative shadows, one may not be able to determine the size of the stones.

The shape and number of stones is, however, a consideration of importance in differential diagnosis. As to shape, they are usually round when single, and flat-sided or faceted when multiple, whereas kidney stones frequently take on the shape of the calices or pelvis, and calcified glands are usually very irregular. There are exceptions to all of these rules which make it necessary to exercise great care.

Reverting to the classification of gall stones: 1. The single, uniformly dense stone, usually more or less round, always presents the problem of differential diagnosis between gall stone and kidney stone. This may be accomplished in any one of a number of ways in most instances. By changing the angle of exposure sufficiently in the direction of the long axis of the body, the gall-stone shadow may fall entirely outside the kidney shadow, or change its position with relation to the shadow of the twelfth rib to such an extent as to prove that the stone is too far anterior to be in the kidney. If the stone is in the kidney, it will not be possible to separate its shadow from that of the kidney, or to displace it materially with relation to the twelfth rib.

If the stone shadow is external to a line drawn through the long axis of the kidney, then it is more satisfactory to displace the tube laterally, moving it well toward the right. This will usually throw the kidney shadow well to the left and free from the gall-stone shadow. This position is of additional value for the reason that the outline of the outer border of the kidney is shown more readily, and further, the gall-bladder that lies far to the right is more readily visualized. Figs. 141 and 142 illustrates the value of this procedure. In the original films, the outline of the dense gall-bladder, as well as the stone shadows, were seen more clearly in the oblique than in the direct postero-anterior exposure.

A direct lateral exposure will at once determine whether the stone is in the anterior or posterior position, especially if the gall-bladder and the kidney are in their normal relation. George

claims this position is of definite advantage in very stout patients, not only for stone diagnosis, but also in the study for adhesions.



FIG. 141

Another method of value is to change the exposure route from postero-anterior to antero-posterior and then compare the size of the stone shadows. Manifestly the film or plate nearer to the



FIG. 142

stone will show the smaller shadow. It is necessary, however, to make certain that motion due to breathing or excessive duodenal

peristalsis has not influenced the size of the stone shadow in the postero-anterior exposure. The element of pressure, too, must be taken into account. This is not a reliable test if the kidney is freely movable.

Stereoscopic exposures may serve very readily to determine the nearness of the gall stone to the anterior abdominal wall, or, rather, its definite distance from the twelfth rib. In fact, stereoscopic films always give one more detail and contrast, and, therefore, more confidence in his interpretation, and the tube displaced in the direction of the long axis of the body is preferable to a lateral displacement, and also permits of the use of the Potter-Bucky diaphragm.

In case any doubt remains after the above procedures, the question may be answered by means of pyeloscopy or pyelography. We have previously described the advantages of this method. Almost without exception the gall stone that has to be differentiated from kidney stone can be seen on the fluorescent screen, and its motion independent of or to a different extent from that of the injected kidney pelvis at once indicates that the stone is not in the kidney. Deep breathing alone may suffice to show this difference in motion. Either the kidney or the gall-bladder may be out of their normal positions, but since the stone shadow, as well as the injected solution, are discernible on the screen, the abnormal position of either presents no difficulty. In fact, if the gall-bladder is low, it is the more easily subject to manipulation, and one can displace it by means of a palpator or the gloved hand without at the same time displacing the shadow of the injected kidney pelvis. This is best accomplished when only a small quantity of the opaque solution has been injected into the kidney. The ureteral catheter should be at least an inch below the level of the uretero-pelvic junction, for in deep breathing the kidney moves up and down to a considerable extent, whereas the catheter does not move, so that if the catheter is in the kidney pelvis or in the upper calyx severe pain may be caused by the interior of the kidney striking the tip of the catheter. We have seen this occur. It is also necessary to keep in mind the fact that the kidney may have a double pelvis. There may even be two ureters, or the ureter may bifurcate at any point between the bladder and the kidney so that one pelvis may not be injected at all, and finding the stone shadow at some distance from the visualized pelvis may be confusing. It is therefore essential that one observe the difference in motion between the stone and the pelvis shadows on the screen, or by roentgenograms show that they are at different antero-posterior levels. Here again stereoscopic roentgenograms are of definite advantage, but care must be taken to see that the patient halts at the same phase

of respiration for both exposures. It is perhaps better to have the breath held at the end of normal expiration. Injection of the kidney pelvis is of particular value in case the stone is in the kidney for one learns its relation to the pelvis or calices, and this of course makes an operative procedure more easy. Fig. 143 is of a stone that was in the kidney and represents an instance of wrong roentgen-

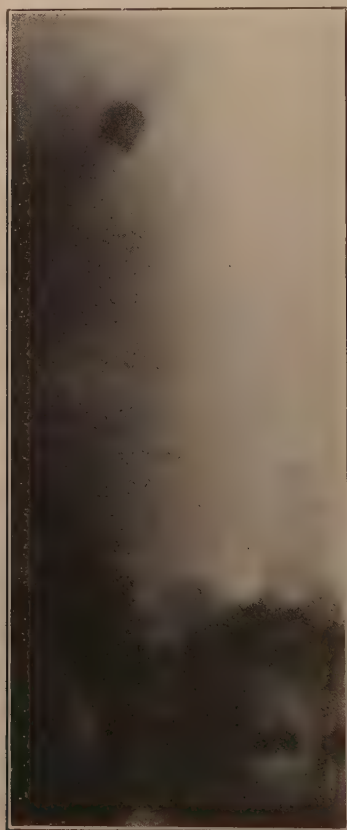


FIG. 143

ray diagnosis. This mistake would not have been made had we injected the kidney pelvis. An unusually large distended kidney pelvis cast a shadow that looked not unlike a kidney in outline, while the kidney was displaced to the right with its long axis parallel to the under border of the liver and presented an appearance not unlike that of a gall-bladder. The stone shadow fell external to what was taken to be the outer edge of the kidney shadow.

This very dense variety of gall stones has in our experience always been rather high in the right upper quadrant where calcified glands are seldom found. It is possible, however, that the occasion may have arisen in the practice of other roentgenologists where it was necessary to differentiate between these two conditions. The calcified gland is usually very irregular in outline, or the individual gland is not uniformly calcified, is seldom single, and may be seen in other parts of the abdomen, much more commonly in the lower quadrants than in the upper.

Another possible source of error might arise if a diverticulum of the duodenum or of the hepatic flexure of the colon were to retain bismuth or barium given for therapeutic or diagnostic purpose. The small diverticula common in the walls of the colon sometimes retain the bismuth or barium for many days. A history of taking bismuth or barium should be easily elicited. Diverticula of the colon are nearly always multiple and if present at the hepatic flexure are almost certain to be present in the region of the sigmoid or other portions of the colon. A diverticulum of the duodenum usually empties or changes its contents more or less rapidly because of the liquid state of the contents in this portion of the gastro-intestinal tract.

2. Multiple dense or fairly dense stones, which by their size, shape, position, and arrangement warrant easy positive diagnosis, require but little consideration. They represent by far the largest proportion of stones that are discovered roentgenographically. As to size, they vary greatly, being sometimes as small as bird-shot, again an inch or more in diameter. As a rule, the stones are nearly of the same size in a given case, but there are exceptions. Fig. 144, shows a large collection of very small stones. It requires fairly close observation to detect these shadows, but once seen there remains no doubt as to their being of gall-stone origin. Fig. 145, shows larger stones, and they are by virtue of their density and number easily demonstrated. It will be seen that they are more or less uniform in size, shape and density. Other variations as to size may be seen in the various illustrations.

The shape of the stones is also to some degree uniform in each case. When they are in contact with each other and not uniformly dense, they are apt to be flat-sided or faceted, as in Fig. 146. When not in contact, they are more nearly round, as in Fig. 147. It is probable that the influence of external pressure determines to a large extent their shape.

The position, as well as the arrangement of the stones, are points of importance. They may be high up in the right upper quadrant in a very much contracted gall-bladder, as in Fig. 148, or far down in the right lower quadrant in a greatly dilated or pendulous gall-



FIG. 144



FIG. 145

bladder as in Fig. 149. These two extremes represent different types of pathological processes in addition to revealing the presence of

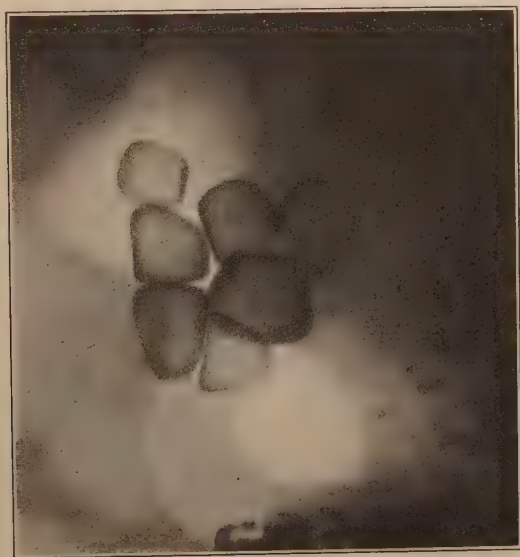


FIG. 146



FIG. 147

stones, and perhaps gives the surgeon an added confidence in his operative procedure. It frequently happens that the gall-bladder casts a definite shadow, especially when it is more or less contracted and fits snugly over its stone contents (see Figs. 141 and 142). Because of the wide variation in position, it is extremely important to include practically all of the right side of the abdomen in the study for stones. When there are three or more stones in the gall-bladder, their uniform size and shape, as well as arrangement, as in a sac,



FIG. 148

are so characteristic that it is not necessary to make special effort to rule out kidney stone or calcified gland. However, the long, narrow, contracted gall-bladder filled with stones more or less irregularly calcified may be mistaken for a partly calcified costal cartilage (see Fig. 148). The stereoscope will suffice to prevent error of this kind, and then, too, comparative exposure of the left upper quadrant should show a similar degree of calcification of the left costal cartilages. One is more apt to fail to recognize faint

stone shadows in patients whose rib cartilages are considerably calcified, than to mistake slight calcification of one or two rib cartilages for gall-stones. If only one or two fairly evenly dense stones are present in a somewhat pendulous gall-bladder, the question of differentiation between gall stones and kidney stones becomes a matter of importance. Pyeloscopy and pyelography give the most reliable information. Improvement in roentgenographic technic may be depended upon to bring a larger percentage of stones into this class.



FIG. 149

3. The next class, viz, collections of dense sand, is relatively rare in our experience. It may be present in considerable quantity, almost filling the gall-bladder, or in so small amount as to be difficult to recognize. The striking feature about it when present is that sand shadow usually has a curved lower border corresponding to the inner wall of the gall-bladder or when in large quantity it takes the shape of the entire gall-bladder. Fig. 150, illustrates the points in question. The convex lower border when clearly seen makes the diagnosis a practical certainty. If necessary to differentiate, methods previously described will suffice.

4. The fourth class, stones, frequently single, having only thin surface deposits dense enough to cast positive shadow, is an extremely important group from the viewpoint of roentgenology. This kind of stone, more than any other, influences the opinion of surgeons as to the value of the roentgen-ray study. The stones

are frequently quite large, and naturally the surgeon is surprised if they have not been discovered during the roentgen-ray study. He does not take into consideration that the calcium deposit on the surface may be very thin, or cover only a portion of the surface,

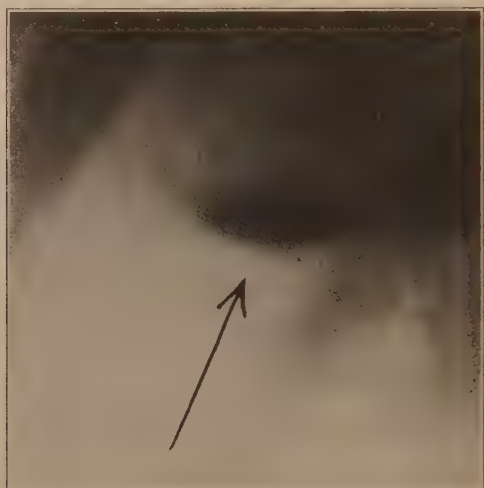


FIG. 150

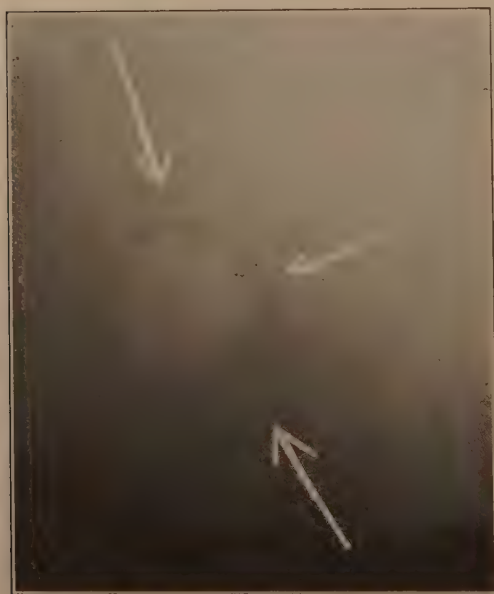


FIG. 151

or be absent entirely. There is definite size and shape, as well as firmness to the touch; also they are called "stones." The roentgenologist who keeps this type of stone constantly in mind and searches diligently for it will have definite advantage in percentage of positive diagnosis over those who fail to respect its frequency of occurrence and its faint shadow-casting properties. The shadow is a circle, Fig. 151, or a portion of a circle, Figs. 152 and 153, and unlike the small deposit of sand the convexity may point upward, to either side, or the circle may be complete. It is usually thin and sometimes very faint. One must find it on a number of films or plates at times before being confident of its existence. The most careful technic is required. The shortest possible time of exposure gives the best result, for the reason that very slight motion spreads an already delicate shadow over a larger surface, blurring detail and diminishing contrast—perhaps even to the point of extinction. The central portions of such stones rarely have distinguishable shadow-casting qualities, although we have in one case found a very small dense central shadow a sort of nucleus, but have not found that they cast the so-called negative shadow to a definite degree. It is possible they may be mistaken for slight calcification of the gall-bladder wall, but this would not constitute a perilous error. In one instance a rather marked atheromatous deposit in the abdominal aorta gave us a bit of concern, but on palpation the aorta was quite prominent and we found the same condition in the arch of the thoracic aorta and also to a much greater extent in the gastric arteries. Then, too, the deposit in the abdominal aorta followed the line of the aorta more than the arc of a circle. As we have said, many of these are single stones, but in several cases many additional small stones not recognized in the roentgenograms were found at operation. In other instances, large numbers of stones are present and each one seems to have the thin calcium surface. The facets of these stones may be recognized and at times the dense coat is so faint that it is in slight contrast only with the interior, so that they may be erroneously considered instances of negative shadows.

5. The next class, stones, usually multiple, which are definitely less dense than surrounding structures and which cast "negative shadows," might be called the speculative group. It is a fact, beyond doubt, that some gall stones do transmit the rays so readily that dark spots instead of light ones appear on the films or plates. This has been proven, not only experimentally, but also by operative procedure on the living subject having such stones. Unfortunately, small collections of air or gas in the intestinal tract cast very similar shadows and are found with annoying frequency and persistency in this region. We know of instances in which roentgenologists

have made errors, mistaking gas shadows for negative stone shadows, even describing the stones as being faceted. One is frequently tempted to consider these negative shadows as of gall-bladder origin, but when one does on such evidence alone, there is apt to

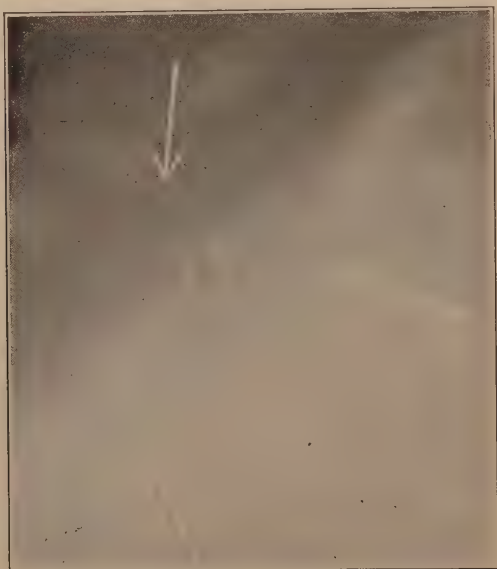


FIG. 152



FIG. 153

be an element of conjecture or speculation about it. On the other hand, there are conditions under which one may make such diagnosis with a fair certainty, and this means that it may be possible at times to differentiate definitely between gas shadows, that are nearly always present, and negative stone shadows, that may be present. Cole was the first roentgenologist to attempt interpretation of negative shadows of gall stones. In his first series of 32 cases, 16 of which were checked by operation, 12 were correctly diagnosed roentgenographically, 3 incorrectly diagnosed, and 1 very provisional diagnosis was incorrect. We consider this a very creditable result, especially in view of the fact that the diagnoses were based alone on roentgenograms of the gall-bladder region and not on gastro-intestinal studies which might have given additional indirect evidence in the cases correctly diagnosed, or, as Cole (4) says: "In 2 of the 3 cases in which an erroneous roentgen diagnosis was made, the real lesion would have been detected if a complete gastro-intestinal examination had been made instead of limiting ourselves to the experimental diagnostic feat of attempting to diagnose the cases solely by detection of direct evidence of shadows of either greater or less density than the surrounding shadows."

When one finds shadows of negative density in films or plates of the right upper quadrant, he should exhaust every means of differentiation before concluding that they are due to pure cholesterin stones. Negative shadows of gall stones should be present in every one of a number of exposures, and even in the exposures made on different days. They should be constant in size and shape, as well as location, with a uniform exposure technic. Collections of intestinal gas should change from time to time, and then, too, one may resort to efforts to remove such gas. Or, by visualizing the intestinal tract with barium sulphate, one may determine that the negative shadows are entirely outside the intestinal lumen, providing the gall-bladder is not covered by some portion of the intestines. The gall-bladder itself may cast a distinguishable shadow and contain within its outline constantly these negative shadows. Again, one may find very positive evidence of adhesions in the right upper quadrant or of deformity of the hollow viscera due to gall-bladder disease. Such findings very strongly support even delicate negative shadows. Fig. 154 illustrates this point clearly. The negative shadows were not due to intestinal gas for the reason that not any portion of the intestine extended into the area in which these shadows were found. The fluoroscopic evidence of gall-bladder disease was strikingly positive. It is probable that the presence of a large quantity of dense pus under tension served to make the negative gall-stone shadows more noticeable because

of the increased difference in density. In other words, the denser the gall-bladder and its contents, the more readily we will find negative shadows of pure cholesterin stones. Fig. 155 shows negative

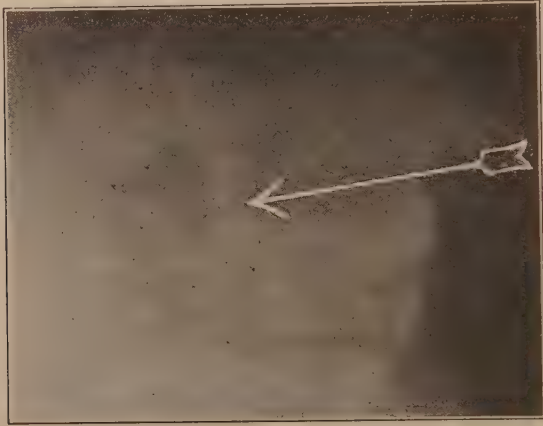


FIG. 154

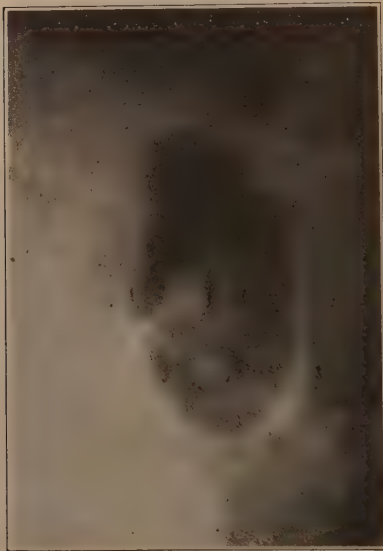


FIG. 155

stone shadows in a gall-bladder whose walls are calcareous. The contrast is more striking because of the increased density of the gall-bladder wall, as well as the lack of density of the stone.

6. Stones, usually multiple, which do not cast distinguishable shadows, represent a large group—probably from 30 to 50 per cent. One reason for this high percentage is that many of the gall-stone subjects are large, stout, and generally dense. The stones found in some of the patients at operation could certainly be demonstrated roentgenographically if they were in smaller subjects. However, there are stones that cannot be demonstrated even in thin subjects and on plates or films of the utmost excellence. The density of such stones is uniform and not in contrast to the surrounding structures or gall-bladder contents. They may be found in gall-bladders containing bile of fairly normal consistency and density and with walls not macroscopically thickened, so that even the gall-bladder outline may not be shown. Both the cystic and common ducts may have a fairly normal lumen. In our opinion, this group of stones is the cause in a large percentage of cases of gall-stone colic. Naturally, one or more attacks of colic, especially if associated with temporary subsequent jaundice, lead to a clinical diagnosis of stone and even though they are not discovered roentgenographically, usually do sooner or later come to surgical operation for relief. On the other hand, the vast majority of patients, in whom we do discover the presence of stones by means of the roentgen rays, have never had an attack of colic; and in a fairly large percentage, there has been no definite clinical evidence of gall-bladder disease in any form; in fact, the symptoms may be referable more to the gastrointestinal tract or even the kidney, as we have stated before. It is entirely probable, too, that sooner or later, as disease of the gall-bladder progresses, many of these stones pass from this group to one of the others by receiving a more or less definite coating of calcareous material. Again, it has frequently occurred that when we have found evidence of gall-bladder disease without demonstrating stone shadows, the surgeon has found stones as well as the diseased gall-bladder, so that taken by itself the percentage of non-shadow-casting stones is of comparatively small significance since the associated disease of the gall-bladder may present evidence almost as positive as if the stones had cast definite shadows. In like manner, the surgeon considers he has made a correct diagnosis if at operation he finds a definitely diseased gall-bladder without stones when he really expected to find stones, and the patient gains just as much from the operation. It is in this class that pneumoperitoneum is of definite advantage. Inflation of the empty colon with air may be an aid. The stone shadows seen in Fig. 146, page 381, certainly show the more clearly because of the large amount of gas in the colon.

The diagnosis of cholecystitis with or without stones can frequently be made by direct recognition of the gall-bladder shadow.

George (6) first called attention to the visualized gall-bladder shadow. After extended studies and checking by operative findings, he concludes that any gall-bladder sufficiently dense to cast a positive shadow is a pathological gall-bladder, but insists that ordinary inspection or palpation at the time of operation must not be relied upon to determine absence of disease. We have no reason to dissent from this view, but it is hardly within the province of the roentgenologist to say that all pathological gall-bladders are essentially surgical conditions demanding removal. It is probable that under favorable conditions a slightly diseased gall-bladder



FIG. 156

may cast a fairly definite shadow. But if the definite gall-bladder shadow indicates a real enlargement of the gall-bladder, as in Fig. 156, one has pretty safe evidence that there is some degree of obstruction to the cystic duct. Marked enlargement, of course, usually indicates complete obstruction of the cystic duct and, as a result, hydrops of the gall-bladder. On the other hand, the gall-bladder may be contracted and have very dense fibrous tissue walls, as well as abnormal bile. The shadow of such a gall-bladder is apt to be quite dense and high in the right upper quadrant. It may or may not contain stones, and the definite density of the shadow is the important diagnostic point. In fact, any gall-bladder casting a

dense shadow, whether large or small, must be more or less extensively diseased. Or, conversely, if the normal or only slightly diseased gall-bladder does cast a recognizable shadow at any time, then the shadow will be lacking in density, even if one can trace its outline. The element of personal judgment, therefore, enters more or less strongly in this sort of direct evidence.

There are several possible sources of error in such a diagnosis. The duodenal cap or a loop of small intestine filled with food, or even colon contents may give a more or less circular outline resembling the gall-bladder. The right kidney is perhaps the most potent factor for error. With the patient in the prone posture, the kidney is usually high and while the lower pole usually shows clearly, the upper pole is apt to be lost in the dense shadow of the liver, so that the portion defined looks more or less like a gall-bladder shadow and is in the same general region. The kidney is sometimes rotated on its long axis and its shadow is narrower than one may expect to find it. Then, too, it may be rotated on its short axis and lie more or less transverse, with the lower pole considerably farther to the right than normal and in a position where the gall-bladder is frequently found. On the other hand, a large distended gall-bladder may cast a shadow of the size, shape and density of the kidney and be overlooked because of its resemblance to a kidney. A linguiform lobe of the liver may be present and give a shadow not unlike a large gall-bladder. This condition is relatively rare, and since it is usually associated with gall-bladder disease, an error in interpretation because of it might not be disastrous to the patient. One need only keep these possibilities in mind and then check up on the preparation of the patient. We feel that if one wants to make a diagnosis of this kind, he should be able to trace at least one-third of the outline of the gall-bladder. A more or less localized area of density without the clean-cut gall-bladder outline is not sufficient evidence. Reëxamination after careful and thorough preparation should be made in doubtful cases.

The diagnosis of gall-bladder disease without any of the direct evidence before mentioned is entirely justified under certain conditions. The findings leading to such a diagnosis are deformity, displacement, or abnormal fixation of the stomach, duodenum, jejunum, or colon filled with barium sulphate, or any combination of these. Functional disturbance, too, may have corroborative value. Of these signs the most valuable is deformity when it takes the shape of the gall-bladder as in Figs. 157 and 158. The duodenal cap may be in the shape of a crescent instead of a cone, or certain coils of the intestine may show the same sort of indentation. The more constant the deformity, the more nearly it is a positive sign of cholecystitis. The assumption is that the normal gall-bladder

contents are not under sufficient tension to produce a constant change in the shape of the surrounding gastro-intestinal parts because of the vigorous peristalsis and greater tension in the latter.



FIG. 157



FIG. 158

Occasionally one may get a very definite idea as to the size of the gall-bladder by the shape of the deformity and, of course, the larger or slower the curve, the more positive is the sign for pathological

gall-bladder. It frequently happens that the gall-bladder producing this deformity is filled with stones. We find it at times when the stone shadows are readily seen, and there is always a strong probability that stones are present, even though they do not cast distinguishable shadows. The deformity of the duodenum or other structure taking its shape by virtue of the convexity of the gall-bladder must not be confused with deformity due to adhesions, for in the latter case the diagnosis is more presumptive, and belongs rather under the other two indirect signs, displacement and fixation.

In 1911, Pfahler (10), called attention to the high position and fixation of the second portion of the duodenum as a sign of pericholecystitis. In 1913 (?), Case described his technic of fluoroscopy and roentgenographing the patient lying on his left side to determine abnormal position and fixation toward the right of the stomach and duodenum in cases of cholecystitis with adhesions. Adhesions in this region frequently produce definite and constant irregularity in gastro-intestinal organs and it is at times very difficult to differentiate between the deformity due to ulcer or new growth of the duodenum or stomach, and the deformity of adhesions of gall-bladder origin. Then, too, adhesions may result from ulcer, and while the deformity may lack ulcer characteristics, it may be impossible to decide that the gall-bladder is or is not the cause. The diagnosis of gall-bladder disease based on evidence of adhesions in the right upper quadrant practically always implies that the gall-bladder is the only source of such pathological process. Of course, in the main this is true except in cases of perforating or deeply penetrating ulcer. In the less advanced cases, the signs must be looked for with great care, and beyond doubt the serial roentgenographic study will at times reveal such evidence when it cannot be obtained by fluoroscopy. A constantly narrowed second portion of the duodenum, with absence of feathered appearance, and perhaps slight acute angulation, are fairly dependable signs but easily overlooked. Fig. 159 illustrates this point. The faint shadow of a large gall stone makes it the more clear. One must constantly keep in mind that he is looking for such indications or he will frequently miss them. When adhesions are extensive and produce any considerable deformity, definite angulation, or fixation in an abnormal position, the diagnosis is relatively clear with either fluoroscopy or plates. The pyloric end of the stomach may be extensively involved and the deformity thus produced may even be taken for an infiltrating process. In the interest of the patient, the roentgenologist should hesitate to make a definite diagnosis of malignancy unless the deformity is quite characteristic. It is far better to note the fact that an organic lesion exists and depend

upon other means of investigation to determine whether or not operation is indicated; and it is our personal view that even if all such evidence leans rather to the diagnosis of growth, exploratory operation at least should be resorted to. When the adhesions involve the first portion of the duodenum, the deformity may be very slight or so extensive as to produce almost complete obstruction. When slight, the resulting deformity may only be recognized after careful roentgenographic technic and repeated exposures, and it may be necessary to have the patient remain quietly in the selected posture for as much as a half hour or even longer in order to catch the duodenum well filled as of course it should be. One should hesitate to rely upon films or plates of a partly filled duo-

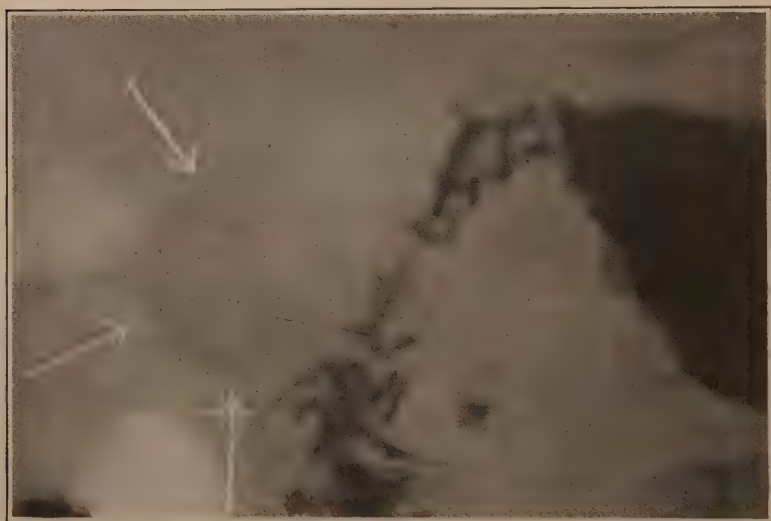


FIG. 159

denum. In the presence of cholecystitis with adhesions to the duodenum, the duodenum is apt to be more or less irritable and will remain more or less contracted for a considerable length of time, but sooner or later will relax if the patient remains perfectly quiet. In this respect the condition resembles duodenitis; only in the latter case, if the duodenum does relax, a normal outline will be obtained. In the case of ulcer, the deformity is apt to be more constant and of the same general shape, whether the cap is partly filled or well filled.

As the adhesions to the duodenum become more extensive, the problem of differentiating from ulcer becomes more difficult and, in fact, in a certain percentage of cases, perhaps from 10 to 15 per

cent, it is impossible to differentiate. In either case, however, the diagnosis of organic lesion is clear and surgery is indicated. When the adhesions produce mechanical obstruction, the stomach undergoes hypertrophy and dilatation, and, just as in obstruction due to duodenal ulcer, hyperperistalsis is constant even after the stomach enlarges to double its normal capacity. (See Fig. 139.)

There are other more indirect signs, such as spasm of the stomach, gastric or duodenal retention, and hyperperistalsis. Carman attaches importance to multiple gastric peristaltic waves even in the non-obstructive cases. These signs are of contributory value only.

Diagnosis of cholecystitis by exclusion may be justified in certain instances, especially when the suffering of the patient indicates a definite pathological condition in the upper abdomen. One can reasonably exclude an organic lesion of the stomach or duodenum, and also rule pretty definitely on the appendix, especially if it can be visualized with barium sulphate. By excluding disease of these parts, we feel that occasionally one is justified in holding the gall-bladder responsible for the symptoms. It is, however, more a clinical diagnosis with supporting evidence obtained by means of the rays.

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CHAPTER XXI.

CLINICAL DIFFERENTIAL DIAGNOSIS OF GALL- BLADDER DISEASE.

BY WILLIAM FITCH CHENEY, M.D.

TWENTY years ago the appendix held first place in medical esteem as a source of abdominal symptoms. Today its claim to supremacy is rivaled by that of the gall-bladder; for gradually the conviction has been reached, based on the experience of many observers, that this organ is frequently diseased and that its importance must constantly be borne in mind in considering the meaning of complaints referred to the abdomen.

What causes the gall-bladder to become diseased so often? Nearly all its pathology can be traced primarily to infection. Microorganisms enter it constantly, directly carried to it by the blood, or indirectly by the bile, or by way of the common duct from the bowel. Careful investigation seems to make it certain that the most frequent road of entrance is from above, not from below, the gall-bladder. In any general infection, such as typhoid fever or pneumonia; and in any localized infection, from a focus in tonsils, tooth sockets, sinuses or elsewhere in the body, germs may be carried in the blood stream to the gall-bladder's walls or in the bile to its interior. To the clinician, the importance of this fact lies in the relation that the patient's previous history bears to the recognition of gall-bladder disease. An attack of typhoid fever years before, or of tonsillitis or of abscess in the middle ear, or of chronic nasal discharge, or of various other general or localized infections, is of value in the clinical history when suspicion of gall-bladder disease has been aroused, because it affords a clue as to how the latter may have been produced.

But not all germs that enter the gall-bladder lead to its infection. Some other factors must exist to determine when microorganisms shall colonize there, to induce a pathological condition, or when, on the other hand, they shall remain as harmless visitors or else be promptly destroyed. Such factors are apparently those that lead to stasis of the bile in the gall-bladder. Thus, lack of exercise, a sedentary life, overindulgence in food, obesity and sluggishness of body have long been looked on as predisposing to gall-bladder disease, and such items in the patient's history are always suggestive.

Once infection has occurred, the changes it induces are manifested in: (1) The contents of the gall-bladder, which become thicker and more viscid, owing to the mixture of the products of inflammation, such as mucus, desquamated epithelium and white blood cells, resulting often in the precipitation of concretions known as gall stones, formed largely from cholesterol, which is derived from the bile or from the cells of the mucous membrane and is present in excess under these abnormal conditions; (2) the mucous membrane, which becomes reddened and granular and often shows minute areas of ulceration; (3) the wall, which gradually thickens and toughens and becomes fibrous, thus contracting and decreasing the size of the organ, and (4) the peritoneal surface, to which other surrounding organs may become attached because of a pericholecystitis, particularly the pylorus and duodenum and the hepatic flexure of the colon. All of these pathological changes are significant, for as one or the other predominates, the clinical picture changes and the evidence available for diagnosis varies.

The most common type of disease of the gall-bladder is a catarrhal cholecystitis, due to a low-grade infection, chronic or subacute, with recurring exacerbations. During the quiescent stage, no symptoms referable to the gall-bladder may be present at all, though reflex ones may arise, referred to the stomach, and due to disturbance of gastric secretions and motility. At the time of an acute intercurrent attack, a sudden flare-up of a previously smoldering inflammation, pain and tenderness over the gall-bladder, fever, reflex vomiting, possibly jaundice, call attention to the site of the disease. If gall stones have formed during a long-standing catarrhal inflammation, one may attempt an escape coincident with one of these acute exacerbations and so give rise to the clinical picture known as biliary colic. If the acute attack is the result of a virulent infection, the cellular products of inflammation usually predominate and the catarrhal becomes a purulent exudate, leading to so-called empyema of the gall-bladder, with increased severity of the constitutional symptoms, higher temperature and pulse rate and with danger of perforation and local or general peritonitis, exactly as with a suppurative appendix. If a stone lodges in the cystic duct on its way out, the result is the gradual formation of a tumor from accumulation of mucus in the gall-bladder; and tumor formation never occurs in gall-bladder disease except from obstruction to the cystic duct by inflammatory swelling or by impacted calculus, or from cancer of the organ. In the former, the tumor is elastic and yielding; in the latter, it is fibrous and hard.

Cancer of the gall-bladder, when it occurs, is usually the ultimate sequel of chronic cholecystitis and cholelithiasis, resulting from irritation by stones. If a stone lodges in the common duct, but

does not completely obstruct, there usually results sepsis with chills, fever and sweats, with recurring attacks of biliary colic and with partial jaundice, varying in degree from time to time; a condition long ago described by Charcot and still known as "Charcot's fever." Thus the various forms under which gall-bladder disease presents itself are not many; and practically all of them originate as cholecystitis. If this can be recognized in its early stages and removed, many disasters that are threatened later on may be prevented, much ill health obviated and death from possible complications may be averted.

For the recognition of gall-bladder disease, the means available are: history, physical examination, laboratory examinations and roentgen-ray screen and films.

HISTORY.

The larger the experience, the more certain the conviction that the history of the condition gives the most valuable evidence of all. For the great majority of cases, which correspond in pathology to chronic cholecystitis and cholelithiasis, there are fairly constant manifestations that permit classification into four distinct groups: These are: Group 1, recurring attacks of colic, with good health between. Group 2, recurring attacks of colic, with more or less constant indigestion between. Group 3, chronic stomach trouble, with subacute gall-bladder attacks. Group 4, chronic stomach trouble, with no history pointing to gall-bladder over long periods of time.

Group 1. These are the cases in which attacks of biliary colic recur at irregular intervals, with good health for months or years between. Their description is usually so characteristic that the story by itself makes the diagnosis. The well-known features of the attack are the sudden onset without apparent cause, the violence of the pain, its site at the right costal margin, its radiation around the right side and under the right shoulder blade, its duration for hours, as a rule, unless relieved by an opiate, and the soreness it leaves behind it after the acute pain is gone. But these typical and characteristic manifestations are not always as described. Variations from the rule occur and lead to confusion. The pain may be felt in the epigastrium and may radiate straight through to the back, suggesting the stomach as its site of origin; or it may be felt at the left costal margin instead of the right; or beneath the sternum simulating angina pectoris; or below the right costal margin so far down as to make one suspect the appendix. If jaundice occurs as a sequel of the attack, it makes the diagnosis practically certain. But this condition may manifest itself only for a few hours,

in the eyes or in the urine, and so be overlooked; while many cases, at least half, never show it at all. The absence of jaundice from the history is by no means so important as its presence, and should never throw doubt on the diagnosis if other details are characteristic. Vomiting frequently occurs at the height of an attack, convincing the patient that some disease of the stomach caused the pain, because the latter often subsides after the stomach is emptied. But so many acute attacks of pain cause vomiting, whether they originate inside or outside the abdomen, that this symptom never identifies the stomach as the site of the disease. All these minor variations from the usual history, due to different radiation of the pain, to the absence of jaundice or to the presence of vomiting, are insignificant in comparison with the main features of sudden onset, severity of suffering, site of the pain, repetition of the attacks after an interval of good health, and other occurrence unexpectedly day or night, with no recognizable cause. This history is the most frequent of all in gall-bladder disease, and is practically diagnostic; but, unfortunately, it represents a late stage, with extensive pathological changes.

Group 2. These cases present the story not only of recurring attacks of colic but also of constant stomach trouble between attacks. In fact, the suffering caused by indigestion makes such an impression on the patient that this usually constitutes the main complaint; and unless the paroxysms of pain are frequent, they may be entirely forgotten until direct inquiry is made about them. Their details are the same in this group as in the former; and the only difference lies in the distressing disturbance of digestion that persists between attacks. The type of this indigestion is not always the same in every case. The story is frequently one of fulness and a sense of weight soon after eating, with persistent gas formation and constant belching. But in many instances the complaint is rather of sour stomach, with heartburn, water-brash, nausea and vomiting of very irritating material. There is, therefore, no characteristic to identify the stomach trouble as due to gall-bladder disease. What does suggest this is the occurrence from time to time of attacks of colic similar in all respects to those described in Group 1.

Group 3. The peculiar feature in this group is the absence of attacks of violent pain such as occurs in the two preceding groups. The chief complaint again is of the stomach and of indigestion. But in addition the patient tells of another kind of annoyance or suffering, constant or recurring, in so-called "spells." This is a feeling of fulness and soreness in the right side at the border of the ribs, as if something were in the way. There is no sharp or severe pain, but a dull, aching and nagging feeling, or a sense of beating and throbbing and of distention. This is usually induced or aggra-

vated by jarring, as by an auto ride, and is frequently relieved by a dose of calomel, which patients learn to take without advice.

Group 4. There are patients that complain much of the condition of the stomach over long periods of time, with no symptoms in the history to identify the real cause of the complaint. Some of them describe discomforts corresponding to those of peptic ulcer; some of them, with "gas" as their major complaint, present the story that usually suggests chronic gastritis; while a few, with no appetite and with a loss of weight in connection with chronic dyspepsia, arouse the suspicion of gastric cancer. Frequently, these cases are assigned to a group called "gastric neurosis," or "nervous indigestion," because no other place can be found for them. There are no attacks of biliary colic to direct attention to the gall-bladder, not even the less serious discomfort described in Group 3. Heretofore, there was really no way to be sure that these cases were due to gall-bladder disease until suddenly, sooner or later, perhaps after the patient had been under observation for years, there came a typical attack of severe pain, such as those described in Groups 1 and 2, to throw light on the previous obscurity, or, until in despair, after trying in vain various dietetic and medicinal cures, the patient submitted to exploratory operation. But recently, by the newer methods of investigation of the fasting stomach contents, of the duodenal contents and particularly of the material obtained by drainage of the biliary tract, sources of information have been supplied that lead to earlier diagnosis, so that these cases in Group 4 can be recognized and treated before the condition has become advanced and surgery is inevitable.

These four groups include the great majority of all patients who have gall-bladder disease; but there are a few complications that may arise modifying the symptoms described or introducing new ones: (1) If at any time in the course of a chronic cholecystitis an acute exacerbation occurs of more than usual severity, with chills added to the clinical picture, higher fever and rapid pulse and a tendency of the symptoms to become more rather than less violent as hours go by after their onset, then the possibility is suggested of a purulent exudate, threatening rupture of the gall-bladder and general peritonitis. (2) If, in addition to a history of frequent recurrent attacks of biliary colic such as those described in Group 1, with more or less constant disturbances of digestion such as those added to the clinical picture in Group 2, there arises a still further complaint of chills, fever and sweat in paroxysms resembling malaria, the probability is great that a stone lodged in the common duct, obstructing and blocking drainage, is producing sepsis from the infected duct contents. (3) Occasionally, but rarely by comparison with other symptoms, the patient speaks of a lump discovered,

palpable in the right upper abdomen. Occurring in a patient whose previous history corresponds to that of any of the groups described, this means the addition of some new complication, usually distention of the gall-bladder caused by a stone impacted in the cystic duct, or else cancer of the gall-bladder. So far as history is concerned, there is no symptom produced by these complications that may not be produced by chronic cholecystitis and cholelithiasis, except that of a palpable tumor. Loss of appetite, loss of weight, loss of color and strength, may occur in the course of any gall-bladder disease, without meaning malignant degeneration; and the pain and indigestion that are usual are not changed in any such way as to become diagnostic of a complication that is unusual.

PHYSICAL EXAMINATION.

The proof of gall-bladder disease that physical examination affords is notoriously uncertain and unreliable. No signs whatever may be discovered at one investigation, even though they are distinctly present at another. All that is ever found may be what the patient feels, not what the diagnostician perceives. But in some cases, nevertheless, the evidence is so plain that it cannot be missed. The possible results of physical examination fall under the following heads:

1. **Negative Findings.**—The gall-bladder lies normally beneath the costal margin and under the edge of the liver, entirely out of reach by palpation through the abdominal wall. Furthermore, the most common effect of chronic cholecystitis is to produce gradually a small, contracted and shrunken organ, even though it contains stones. It is not surprising, therefore, that during long periods, when there is no active inflammation going on, nothing abnormal can be detected by palpation, even though the changes already produced are causing reflexly incessant gastric distress.

2. **Subjective Evidence.**—Too much dependence ought not to be placed on what the patient feels, unless the palpating hand at the same time discovers some definite change from normal. Tenderness over the gall-bladder area, no matter by what method or maneuver it is elicited, is not enough by itself to justify the conclusion that the gall-bladder is diseased.

3. **Objective Evidence.**—What one can expect to find is increased resistance and rigidity, or a palpable tumor, in the right hypochondrium.

(a) Unusual resistance to pressure at the right costal margin as compared with the left, together with pain caused the patient by this manipulation, is the utmost to be anticipated from cholecystitis. Even this is not constant. It may be found at one time and not at another; and undoubtedly its presence or absence depends

on whether or not there has been recent acute inflammation. It is much more likely to be discovered soon after an attack of biliary colic or during the periods of dull, aching pain and sense of distention in the right side. In the intervals of quiescence, for weeks or months, no such abnormality is demonstrable, even though an extensive pathological condition exists, as shown by subsequent operation.

(b) A definite tumor in the gall-bladder area means some complication. It is not found in the great majority of cases of chronic cholecystitis and cholelithiasis. Its discovery implies one of three things: (1) An unusually virulent type of acute inflammation, with seropurulent or purulent exudate, with rapid distention and threatened perforation; (2) obstruction of the cystic duct by a stone and gradual distention of the gall-bladder by accumulation of mucus; (3) cancer of the gall-bladder. Of course, the first question to decide is whether the tumor found really originates from the gall-bladder; and this, as well as the character of the tumor, is determined by consideration of all the other evidence furnished by the history, by laboratory examinations and by roentgen ray, as well as by physical examination.

LABORATORY EXAMINATIONS.

1. **Stomach Contents.**—Investigation of the contents of the stomach gives more information now than it did a few years ago, because of better methods. These include examination of the fasting stomach contents as well as of those obtained after the Ewald test meal by half-hour extractions. While neither examination of fasting contents nor fractional analysis after a test meal gives data that are diagnostic of gall-bladder disease, these procedures are valuable because they help to exclude intragastric pathological conditions and to prove that the digestive symptoms of which the patient complains are produced reflexly by conditions outside the stomach. Two findings, however, suggest gall-bladder disease, even though they do not prove it. The first of these is the presence of bile in the fasting contents, not merely a chemical trace, but an amount visible and obvious to the naked eye. Lyon (4) is convinced from his studies that bile is normally discharged into the duodenum only in response to the stimulus of taking food, and should not be present there in the fasting state. Even so, it cannot find its way into the stomach except by regurgitation due to reverse peristalsis in the duodenum; and this is most often the result of adhesions between the duodenum and the gall-bladder, though these may be produced by ulcer or other disease outside the gall-bladder, as well as by cholecystitis.

Whatever the explanation, bile in the fasting stomach is abnormal and serves to arouse suspicion of gall-bladder disease. The second finding of significance is a clean achylia. The fasting contents tell whether the stomach is really clean or contaminated by an excess of mucus, by blood, by pus or by abundant microorganisms, indicating intragastric pathological conditions; while the fractional gastric analysis determines whether there is a true achylia during the whole digestive period, or only delayed secretion making its appearance later than the first hour and so overlooked by the old method of analysis. Not all gall-bladder cases, by any means, produce achylia; in fact, my own series of cases show hypersecretion occurring more often than hyposecretion. But from experience acquired not only in gall-bladder dyspepsias but also in other types of chronic gastric disorder, the conclusion seems justified that while either increased or decreased secretion may be caused by gall-bladder disease, achylia is found associated with it more often than with any other extragastric disease. Therefore, the discovery of this lack of secretion in a patient whose history is already suspicious adds one more bit of evidence pointing toward chronic cholecystitis.

2. **Duodenal Contents.**—The method of intubating the duodenum has been described in an earlier Chapter: In fasting, bile in the duodenal contents is not the rule; but whether its presence means disease of the biliary apparatus or simply some reflex disturbance of its functions is not yet determined. Bile should be poured into the bowel only in response to the stimulus of food; its discovery in the fasting contents is therefore suggestive of some abnormality. Smears examined microscopically determine the presence or absence of red blood corpuscles, pus corpuscles, desquamated epithelium and microorganisms; and of particular importance, according to Einhorn, (2) in the diagnosis of a diseased gall-bladder, is the finding of cholesterin and calcium bilirubin crystals. Intestinal parasites not previously suspected as a possible cause of disease in the upper right quadrant may be found in the duodenal contents; such, for instance, as the flagellates *Giardia*, (4) which colonize by choice in the duodenum, but about the pathogenicity of which there is still question. It is said that they may cause symptoms resembling those of cholecystitis. *Endamæba histolytica* has never been found in duodenal contents or in the bile, even though the gall-bladder is occasionally a carrier and continues to supply the organisms to the bowel until it is surgically removed.

3. **Gall-bladder Contents.**—If only these contents of the gall-bladder could be obtained, they should give the most conclusive evidence as to the presence or absence of gall-bladder disease. How to segregate gall-bladder bile for examination by itself has, therefore, been the object of much recent investigation. In 1919,

Lyon (3) announced that he had found a way to do this. He utilized an observation published by Meltzer, in 1917, (5) that when the sphincter at the mouth of the common duct relaxed, the gall-bladder contracted by a law of contrary innervation; and as magnesium sulphate solution injected into the duodenum relaxed the sphincter of Oddi, he suggested that, by this means, one could induce the gall-bladder to contract and eject its contents. On this theory, Lyon constructed his plan for gall-bladder drainage. After the tube is proved to have entered the duodenum, by the alkaline reaction and the character of the material withdrawn, 75 cc of a 33 $\frac{1}{3}$ per cent solution of magnesium sulphate is infused. After a few minutes of aspiration, the bile obtained becomes much darker and thicker, and this material is assumed by Lyon to come direct from the gall-bladder and to be available for study as a means of recognizing disease in that organ. If it is unusually thick and tarry, particularly if it contains mucopurulent flakes, pus cells, bacteria, grains of sand or small stones, such findings are interpreted as indicative of chronic cholecystitis.

Recently, however, much doubt has been thrown on this whole procedure. Even Meltzer's original theory has been disputed. Experiments have been made (1) showing that, with Lyon's tube passed into the duodenum and with the gall-bladder under direct observation during subsequent laparotomy, when the magnesium sulphate solution was introduced no stimulation or contraction of the organ occurred and no bile flowed from it unless it was compressed by hand.* The conclusion is that the dark, thick bile cannot be assumed to come from the gall-bladder rather than from the ducts, either extrahepatic or intrahepatic; and that whatever abnormal elements are found cannot be considered to indicate disease of one part of the biliary tract rather than of another.

The whole matter is thus at present in a state of controversy and uncertainty. Every man must form his own conclusion, based on his own experience; and from my own observation, though limited, I am convinced that the procedure is of value in diagnosis and helps in the recognition of disease of the biliary tract. Ultimately, the degree of this value will be determined, but only by repeated tests, and never by abandoning the attempt to acquire further information.

4. **Feces.**—To search for gall stones in feces after an attack of biliary colic is scarcely worth the time it consumes. One may easily be overlooked, and its absence is not significant, if the attack has been typical. Usually, its discovery is not essential to the

* See Chapter VII, page 139 (Lyon).

diagnosis. Clay-colored feces signify deficient bile and undigested fat, but not necessarily any disease of the gall-bladder; more often disease of the common or hepatic duct. Intestinal parasites may cause symptoms of pain in the upper abdomen, with indigestion, such as characterize disease of the gall-bladder; and the discovery of segments or ova in feces sometimes clears up a diagnosis previously obscure. Attention has already been called to the possibility that amœbic dysentery may be kept up by organisms lurking in the gall-bladder, and that *Giardia* may produce a clinical history simulating gall-bladder disease. The discovery of these parasites in the feces is therefore of importance with reference to the gall-bladder, as well as to the bowel itself. Finally, the persistent presence of occult blood in feces is more significant of duodenal ulcer than of cholecystitis, and may help to throw light on the nature of the disease causing pain and tenderness in the right upper quadrant.

5. **Urine.**—During and for a short time after an attack of biliary colic, the urine is not infrequently dark brown, and analysis shows that it contains bile, even when no other signs of jaundice appear. This is always significant and helps to determine the meaning of a paroxysm of abdominal pain. Bile in the urine, for instance, does not result from the passage of a renal calculus; and, on the other hand, blood in the urine is not a consequence of the passage of a gall stone. Normal urine after an attack of pain, showing neither bile nor blood, does not exclude gall-stone colic, but it does speak against renal stone. In the intervals between attacks or in the chronic cholecystitis cases of Groups 3 and 4, the urine is normal and gives no aid in direct diagnosis of gall-bladder disease, though it must be remembered that chronic pyelitis, either tuberculous or pyogenic, may give rise to recurring attacks of pain in the right upper abdomen and back, and that the discovery of pyuria during periods of freedom from symptoms may furnish a clue as to what such attacks mean.

6. **Blood.**—The blood count at the time of an acute cholecystitis shows a leukocytosis, and in the acute purulent variety the white count may be very high; but in the quiescent interval between acute attacks, or in the chronic cases in Groups 3 and 4, the blood count affords no aid in diagnosis, for there is no formula that is characteristic.* Every clinical picture presented by gall-bladder disease may be simulated by syphilis of the liver, so that the Wassermann test should be made as a routine procedure. Sometimes this test will save the patient from needless surgery.

* In chronic gall-tract disease where the gall-bladder or ducts harbor a concealed focus of infection, with lowered resistance, the blood picture will more often show a *leucopenia* with a relative *lymphocytosis* (Lyon).

FLUOROSCOPY AND ROENTGENOGRAPHY.

No one can doubt by this time the value of fluoroscopy and roentgenography in diagnosis. Nevertheless, the evidence given by this method of diagnosis is not infallible and must not be accepted as unassailable. In a given case of gall-bladder disease, it may add nothing to the data collected by the history, physical examination and laboratory findings; and yet its negative report must not be understood to prove all other witnesses wrong. On the other hand, it may appear to implicate the gall-bladder when no disease is there, and call attention to abnormalities that are shown by operation not to be present. It is not fair, therefore, to exalt this method of diagnosis to a pedestal above all others or to claim for its pronouncements the rank of Delphic oracles.

The evidence obtained by roentgen-ray examination is of three kinds: direct, indirect and eliminative.

1. Direct evidence means the demonstration of changes in the gall-bladder itself, either the shadow of its outlines or of stones within it. But it is admitted that not more than half the cases show such peculiarities in the films even when they really exist in the body; and, unfortunately, at times they show in the films when they do not exist in the body, as proved later at operation. The margin of error is, therefore, a large one, and neither positive nor negative reports are so reliable that they must be accepted if they conflict with the data obtained by other methods.

2. Indirect evidence means the demonstration given of effects produced on surrounding tissues by gall-bladder disease, such as flattening or deformity of the duodenal cap, reverse peristalsis in the duodenum, displacement of the stomach to the right, or a high fixed position of the hepatic flexure of the colon. All of these signs are produced by pericholecystitis with resultant adhesions between the gall-bladder and adjacent organs. But pericholecystitis does not always occur as a complication of chronic cholecystitis, and, therefore, none of these results may follow. Their absence is not conclusive evidence against gall-bladder disease, just as their presence may be the result of localized peritonitis originating from disease in the pylorus, duodenum or colon, rather than in the gall-bladder.

3. Eliminative evidence means the proof given of normal stomach contour and motility, showing that the digestive symptoms are not due to organic disease of that viscus; of no defects in the duodenum such as are ordinarily found in chronic ulcer; of no cecal or appendix stasis or other evidences of a chronic appendicitis; and of no break in the continuity of the ascending or the transverse colon. These negative findings are of great value, even though no positive signs of gall-bladder disease are demonstrated.

INTERPRETATION OF DATA.

Such are the various methods by which evidence is collected regarding gall-bladder disease, but there remains the task of weighing the significance of the facts thus obtained, in the light of the various abnormal conditions that may have produced them. Many questions arise for answer before proper interpretation can be made of these data. These questions concern:

1. **The Biliary Tract.**—(a) Is it possible to recognize chronic cholecystitis in its early stages before stones have formed? It seems probable that these cases are the ones corresponding in history to Groups 3 and 4, with negative physical findings except occasionally after an attack of discomfort in the right side; with achylia or definite hyposecretion; and with none but indirect or eliminative evidence obtained by fluoroscopy and roentgenography. It is just here, in these early stages, that Lyon's plan of gall-bladder drainage promises to be of service, by the information it gives about the cytology, bacteriology and chemistry of the bile; and it should make possible the recognition of gall-bladder disease before it has reached the late stage of cholelithiasis, with contraction and thickening of the gall-bladder walls.

(b) How can cancer of the ducts be identified? This condition, no matter whether it originates above or below the junction of the cystic duct with the hepatic duct, sooner or later obstructs the common duct and thus produces jaundice. Usually, it gives rise to a series of attacks of pain closely resembling those of gall-stone colic, with good health between attacks; but ultimately jaundice appears and persists. Physical examination reveals a slightly enlarged liver, because of obstruction to bile discharge. An enlarged gall-bladder may or may not be found. If the opening between the hepatic and the cystic ducts remains patulous while the common duct is occluded, the gall-bladder usually becomes enlarged from overdistention; but if the hepatic duct is blocked above or at the junction with the cystic duct, so that no bile can enter the gall-bladder, no enlargement may occur. Gastric achylia is the rule in these cases. No bile can be obtained for examination, because none is poured into the duodenum. Roentgen-ray reports are negative, if they are correct. Inference usually suggests the diagnosis, but exploratory operation is required to prove it; and usually that is its main virtue.

(c) When jaundice is obviously present, what proof is there that it is due to catarrh of the ducts? This so-called catarrhal jaundice should be looked on as part of a gastro-duodenitis. Its history does not include severe pain, but constant indigestion, with anorexia, nausea and vomiting preceding jaundice. In this condition, the

Lyon procedure is of special value, not only in diagnosis, but also in treatment, in the information it affords as to the character of the material obtained from the fasting duodenum and from the biliary tract, and in the relief given by drainage and by duodenal lavage. By fractional gastric analysis, by examination of the duodenal contents and by biliary drainage a positive diagnosis can be made of angiocholitis, even when the history is indefinite and all other methods fail to give reliable information.

2. **The Liver.**—This must be remembered as an important source of symptoms of gall-bladder disease, resembling those met in Groups 3 and 4.

(a) Cirrhosis of the liver produces a chronic disturbance of the stomach, with or without a sensation of dull pain at the right costal margin; and over long periods of time these may be the only manifestations of chronic portal cirrhosis. Physical examination in the early stages reveals an enlarged and tender liver; gastric analysis gives a material characteristic of chronic gastritis, with achylia or hyposecretion, but also with excess of mucus, and often with blood, pus and microorganisms in the fasting contents; there are no peculiar features in duodenal contents or in the bile itself to identify the disease, and roentgenograms show no abnormality.

(b) Chronic passive congestion of the liver, secondary to a faulty heart muscle, may closely imitate the chronic dyspeptic symptoms, with hepatic enlargement and tenderness, that characterize hypertrophic cirrhosis; but the signs of a weakened myocardium and poor circulation make it impossible to overlook the underlying cause.

(c) Syphilis of the liver, as already mentioned, may simulate the history given by any one of the four groups of gall-bladder disease, and the only way to eliminate it is by the Wassermann reaction.

(d) Cancer of the liver, except as a metastasis, is unusual. Primary cancer of the liver causes digestive disturbances with pain in the liver region, but it causes also a definite enlargement of this organ, either smooth or nodular, too striking to be accounted for by gall-bladder disease alone.

3. **Diseases of the Stomach.**—These constitute so large a chapter that they cannot be considered here except in a general way. Any of the forms of intragastric disease, such as gastritis, ulcer or cancer, produce digestive symptoms closely resembling those of which complaint is made in gall-bladder disease. But each one of them shows on gastric analysis not only disturbances of secretion, but also the presence in the fasting contents of abnormal constituents, such as mucus, pus, blood, microorganisms or retained food, which are not present in the reflex disturbances of secretion caused by

extragastric disease. Furthermore the fluoroscope and roentgenograms reveal defects in the stomach wall, when ulcer or cancer causes the symptoms, while they eliminate these conditions from consideration if no such defects are demonstrated. In gall-bladder disease, on the other hand, the clean stomach, no matter what its secretion is, the peculiarities found in the duodenal contents in fasting, and the discovery after biliary tract drainage of material, such as never comes from the normal gall-bladder and ducts, help to decide where the pathological condition lies.

4. **Chronic Appendicitis.**—This, as well as chronic cholecystitis, is characterized by recurring attacks of abdominal pain, with or without persistent dyspepsia in the intervals between attacks. Appendicitis may thus give a history corresponding more or less closely to any one of the four groups described. Usually, however, the location of the pain is distinctly different; in the right lower rather than the right upper quadrant, with all the physical signs likewise found lower down. It is possible, however, for an inflamed retrocecal appendix, with its tip pointing upward along the ascending colon, to produce pain referred to the right costal margin; and for an inflamed gall-bladder to give rise to pain referred downward toward the usual site of the appendix, so that confusion is bound to occur about the diagnosis, if the history and the physical examination constitute the only guides. Gastric analysis does not aid much in differentiation, for while it demonstrates that the stomach disturbance is due to some extragastric condition, it does not identify that condition. Examination of the duodenal contents and material obtained by drainage of the biliary tract may be sufficient to settle the question of gall-bladder disease, no matter what other methods show. The roentgen-ray examination also adds data of great value when considered in connection with all the other symptoms and signs. But, after all, it is not uncommon to find coincident disease of the appendix and the gall-bladder, so that the evidence is mixed, and exploratory operation then becomes the court of last resort.

5. **Disease of the Right Kidney.**—This frequently causes acute attacks of pain in the right upper abdominal quadrant; such conditions, for instance, as renal calculus, pyelitis, whether septic or tuberculous, and recurring hydronephrosis due to a kink in the ureter as a result of prolapse of the kidney, the so-called Dietl's crises. In all these attacks, the history is usually one of pain referred downward toward bladder and genitalia, rather than around the right costal margin and under the right shoulder blade; with frequent and painful urination while the attack persists. Localization of the real site of the pathological condition is made by cystoscopy, ureteral catheterization, pyelograms and roentgenograms.

By these means, it is possible to identify disease in the kidney, and by other means, previously described, to eliminate disease of the gall-bladder, no matter how lacking the history of an attack may be in features that distinguish one condition from the other.

There remain for consideration two groups of diseases in which the pathological condition is entirely outside the abdominal cavity, but in which the symptoms are manifested in such a way and are of such a character that they simulate gall-bladder disease. These groups comprise certain affections of the nervous system and of the thoracic organs.

6. Disease of the Nervous System.—Under this heading must be remembered: (a) The gastric crises of tabes. These are characterized by violent pain in the upper abdomen, with coincident vomiting and prostration, so that the attacks may closely resemble biliary colic. Usually, the paroxysms begin suddenly and last a variable time, from hours to days; and between them the patient enjoys good health. But physical examination of the abdomen is negative; examination of the eyes, the knees, the ankles or the soles will reveal disturbance of reflexes; roentgenograms of the gastrointestinal tract are negative; and the only laboratory investigation that is conclusive is that of the spinal fluid, which shows an increased cell count and a positive Wassermann reaction. By disturbed reflexes, therefore, and by abnormalities in the spinal fluid, it is possible to recognize the gastric crises of tabes; and yet no other cause of acute abdominal attacks probably goes so often undetected.

(b) *Lead Colic.* This condition belongs in this group because it is due to stimulation by lead of the motor nerves in the intestinal wall, causing violent spasm and contraction. The pain produced is felt about the umbilicus, but often radiates from there into the right hypochondrium or right hypogastrium, suggesting biliary or renal colic or appendicitis. It is severe but seldom lasts long, and may be repeated frequently, but without disturbance of digestion between attacks except for obstinate constipation. The discovery of anemia, of basophilic degeneration of the red cells, of a blue line on the gums, of other disturbances of the nervous system such as tremor, palsies and impaired sight, with a history of some occupation in which the patient is constantly subjected to poisoning by lead, suffice to make the diagnosis clear, if only one is alert to the possibility.

(c) *Intercostal Neuritis.* Sudden onset of severe pain referred to the abdomen over the right hypochondrium, with tenderness there, may persist for hours or a day or two before a typical eruption along the course of an intercostal nerve calls attention to the diagnosis of herpes zoster. Careful examination, meantime, of the abdomen, with no signs of gall-bladder disease, and of the back,

with demonstration of a tender point at the nerve exit from the spine, and of others between the ribs along its course, should give a clue as to the meaning of the pain; but it is sometimes difficult to remember the unusual possibility and not to fix the attention rather on the stronger probability that disease of the gall-bladder is responsible for the symptoms.

Less sudden and severe but no less suggestive is an ordinary intercostal neuralgia on the right side, with pain more or less constantly referred to the right upper abdominal quadrant. All the methods of examination described for gall-bladder disease give negative results, while tender points along the nerve trunk, in the back, axillary line and abdominal wall serve to identify the real source of the pain. This is a common ailment, but more than once it has been overlooked in differential diagnosis, because it seemed too simple an explanation.

7. Disease of the Thoracic Organs.—Attention has been called many times, by different observers, to the fact that lobar pneumonia may produce pain referred to the abdomen, with rigidity and tenderness of the abdominal wall, suggesting acute cholecystitis or appendicitis or peritonitis; also diaphragmatic pleurisy from any cause may manifest itself by pain felt below the diaphragm and apparently due to disease of some abdominal organ, a fact to which many observers have called attention. But the thoracic condition most often simulating gall-bladder disease is angina pectoris. Sometimes the pain in this affection is referred to the epigastrium and right hypochondrium and felt there with greatest intensity. The usual substernal distress may or may not form a part of the paroxysm. The history of onset following exertion or violent emotion is characteristic of angina and not of biliary colic; but this history is not always elicited. The expected signs of heart disease or of general arteriosclerosis may not be found. Physical examination of the heart may reveal little abnormality in rate, rhythm or sounds, and blood-pressure may be normal, even though coronary artery disease exists. Roentgenograms of the heart and electrocardiograms may likewise reveal no evidence of disease sufficient to explain the attacks of pain. But laboratory examinations of the gastric and duodenal contents and of material obtained by biliary drainage may give evidence of such character as to prove the existence of gall-bladder disease and so solve the problem. The matter of first importance is to remember that one condition may resemble the other so closely as to be mistaken for it; for operation on the gall-bladder is not suitable treatment for angina, while on the other hand a bad prognosis of sudden death from coronary artery sclerosis may be made unjustly when removal of gall stones would effect a cure.

Many pitfalls to trap the unwary lurk in the path of the diagnostician; and he must be familiar with all the possible snares if he is to win through safely to his goal. The best guide to take on the way is the old maxim, "Eternal vigilance is the price of success."

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CHAPTER XXII.

GENERAL DISCUSSION OF A DIAGNOSTIC SUMMARY FROM AN ILLUSTRATIVE CASE.

GENERAL DIFFERENTIAL DISCUSSION.

It is to be noted that the order of the various examinations was shown in the diagnostic charts immediately following the index.¹

1. History and physical examination, with the provisional or mental diagnosis obtained from this.

2. Twelve-hour motor meal with examination of fasting residuum, followed by fractional gastric analysis with an Ewald breakfast, with an analysis of the chemistry, microscopy and bacteriology of the fasting stomach, and the diagnostic impression from a total analysis of this diagnostic step. It is to be noted that in cases of complete chemical achylia it is not necessary to test for the preservation of gastric enzymes which are rarely, if ever, found. The differentiation between a chemical and psychical achylia can sometimes be made by determining the preservation of the pro-enzymes, pepsinogen and renninzymogen by activating the gastric juice with the addition of hydrochloric acid and retesting.

3. Biliary-tract drainage for purposes of diagnosis, with a summary of the diagnostic impressions to be obtained from this procedure.

4. Laboratory analyses of the urine, of the blood and of the stools, with functional tests of the kidneys and of the intestinal motility. In a case of this kind in which cancer is considered as one of the diagnostic possibilities it is not wise to lose valuable time in the examinations into the more elaborate blood and pancreatic studies simply for the purpose of accumulating all possible data, unless it be considered that by so doing important diagnostic positive findings will be obtained. It is better to select from our differential tests those which particularly apply to the patient undergoing a diagnostic survey.

5. Roentgen-ray examination of the gastro-intestinal tract, including a fluoroscopic study of the chest. It is to be noted that the roentgen-ray examination, of all the important steps in diagnosis, is put last in the order of performance for the reason that I believe that such a method of diagnosis should be made supple-

¹ The diagnostic charts referred to have been placed immediately following the index in order to avoid weakening the binding of the book.

mentary to the various diagnostic clinical procedures. This permits the roentgen-ray study to confirm or to negative or to amplify the total clinical diagnosis.

As a result of the history and physical examination the provisional diagnostic possibilities that suggested themselves were carcinoma of the stomach, perhaps involving the cardia, chronic gastro-enterocolitis, chronic pancreatitis, a possibility of gall stones, a possibility of Bright's disease, and a possibility of mediastinal new growth. Let me pick out and tabulate the important salient features of the total diagnostic study and attempt to fit them in to the completed diagnostic conception of her case, and discuss the various explanations that may be brought out from each of the more important points. (See preceding diagnostic charts.)

A. The patient's family history is an unusually excellent one and gives no clues.

The patient's past history is not strikingly suggestive, although certain points attract attention, namely, the negative history of past infections, with the exception of childhood diphtheria, of recurrent tonsillitis, influenza (mild), subacute appendicitis, twelve years ago "frozen out," and subsequent tendency to abdominal cramps. No jaundice at any time.

It is to be noted that she has had recurrent attacks of tonsillitis, but none for ten years, and the examination of her tonsils shows them to be atrophic and apparently negative for present infection. Nevertheless, we frequently get this sort of history and have learned that a primary focus of infection may gradually die out, but that it has very often established secondary foci lower down in the gastro-intestinal tract. These tonsils may formerly have been the seat of a streptococcic infection which might have been transplanted to the stomach producing an infective atrophic gastritis resulting in complete achylia, and, in turn, have infected the gall-bladder and the enterocolon, for from all three sources we recovered streptococci. One should also remember that with a history of recurrent tonsillitis, even scarred, buried or atrophic tonsils may harbor a definite focal infection posteriorly or centrally, and the surface crypts may appear negative.

Very frequently a history of oral sepsis (gingivitis, pyorrhea, abscessed or decayed teeth) or sinusitis or chronic intracapillary bronchitis precedes the development of a gastric achylia, and this in turn, may be associated with the blood picture of pernicious anemia. In this case, however, all such factors are negative. The possibility of a subacute appendicitis may have been only a part of a disseminated gastro-intestinal infection and it too may have

died out as a fulminating focus as this patient grew older and her appendix became fibrous and atrophic. The tendency to loose bowels (without a real state of diarrhea) may have been due to gastro-intestinal irritation, to pancreatic failure, secondary to the achylia gastrica, or might as easily be accounted for by the Giardiasis.

B. The present history, ushered in by an acute attack of diarrhea eighteen months ago and lasting for one month, is the first break in an unusually robust state of health in a woman of middle age. Since then all of her symptoms have been progressive and in certain respects rapidly so. She has lost 40 pounds, or nearly one-third of her best body weight, in approximately nine months. This is partly accounted for by her increasing meagreness of diet, but also suggests weight loss from neoplasm. It is difficult to rule out gastric cancer which is suggested by the achylia with moderate bleeding in stomach and in stools, although gastric bleeding is often also associated with benign achylia. The doubtful-to-positive Wolff-Junghans reaction for soluble albumen is suggestive of malignancy, but is not supported by the finding of positive lactic acid, the Oppler-Boas bacillus, or a cytological gastric residue picture suggestive of necrosis. (See Chapter XIII.) On the other hand, a low grade streptococcic infection of the stomach of presumably long duration could very well bring about a complete destruction of gastric mucosal epithelium, and gradually produce a benign achylia.

The sense of epigastric pain distress, radiating *not* around the right costal margin to the back, but upward into the mediastinum, coupled with the possibility of dysphagia involving the cardia, is not so clearly suggestive of gall-tract pain as of the possibility of cancer at the cardia or of mediastinal new growth. Both of these conditions, as well as cancer elsewhere in the stomach, appear to be ruled out by the negative roentgen-ray examination, although there was an incisura intermittently present along the lesser curvature. The ill-defined sense of epigastric mass suggested possibilities involving the stomach, the pancreas or a rolled-up omentum which could only be finally interpreted at the subsequent celiotomy.

C. The explosive attack of one month's diarrhea at the beginning of the present illness might be due to the achylia gastrica followed by a sudden break in pancreatic compensation or to a lighting up of a chronic Giardiasis, or to a cancer of the stomach or bowel, although in the latter case we should have found evidence of pus in the stools and a greater degree of occult bleeding.

D. Gall stones or gall-tract disease can by no means be ruled out on the analysis of the history, physical examination or certain of the laboratory studies. Against restive gall stones or gall-tract disease is the failure to obtain a characteristic history of sore-

ness and distress and pain in the right hypochondrium radiating outward along the costal margin to the right back or shoulder blade, existing between the acute attacks of pain; the negative physical finding for tenderness, rigidity or spasm or palpable mass in the upper right quadrant; the negative points of tenderness along the intercostal nerves or at spinal roots, and the absence of jaundice at all times. Of course, the history of three or more recent acute attacks of epigastric pain accompanied by sweating and elevation of temperature might suggest a gall-stone colic, although not severe enough to require morphine or to give a clear cut picture of biliary colic due to a stone in passage, but this general type of epigastric pain could as readily be produced by many other conditions as by gall-tract disease.

In favor of gall stones (quiescent) we have the evidence of a preëxisting gastric anacidity, which, as we know, undoubtedly predisposes to cholelithiasis by depriving the duodenum of the normal stimulus to gall-bladder contraction afforded by an acid gastric chyme, and which thus permits the bile to become concentrated and stagnant within the gall-bladder; the recovery by biliary tract drainage of biles supersaturated with cholesterolin and other unidentifiable crystals associated with tall columnar epithelium, occasional pus cells, an increase in mucus floccules and an increased bacterial flora of Gram-positive cocci, occurring in colony formation, with the cultural recovery of a non-hemolytic streptococcus. Also by biliary-tract diagnostic drainage we established a dysfunction of Oddi's sphincter in the finding of fasting biliary regurgitation and a relaxed sphincter on duodenal intubation.

Certainly we could well argue that in the presence of a gastric achylia, coupled with the finding of excessive bile crystals thrown out of solution, that if gall stones had not already formed the patient was in a most favorable precalculus forming stage. The roentgen-ray examination made at the conclusion of all clinical studies definitely proved this aspect of the case by demonstrating a large and long gall-bladder containing numerous small stones. (See Fig. 160 on page 417.) But there is no reason why this patient could not have gall stones *coincident* with mediastinal new growth, stomach or bowel cancer or gall-bladder cancer. The latter possibility would appear strongest and the former less likely in view of the collected evidence.

E. Chronic disseminated gastro-cholecysto-enterocolitis not only cannot be ruled out as a major factor in this case, but appears to have been proved by the demonstration or cultural recovery of streptococci from the stomach, the gall-tract and appearing as 50 per cent of the bacterial flora as estimated by the Gram-positive stained smears from the feces.

F. Chronic pancreatitis cannot be ruled out in view of the achylia, the presence of gall stones and a widespread but low grade pyogenic infection, and it most probably plays some part as a minor or contributing factor to the total picture of this patient's ill health.

G. Bright's disease can be excluded on the basis of the urinalyses and the normal functional kidney test. In a woman aged fifty years, there might naturally occur some depreciation of structural



FIG. 160

integrity and function of the kidneys which might be made evident only by repeated urinalyses and functional tests, supplemented by nephritic test diets and studies of the blood chemistry. Yet I think we can certainly exclude Bright's disease as a major diagnosis.

H. The accidental and totally unexpected recovery of quantities of living *Giardia* from the duodeno-biliary floccules of mucus is interesting in view of the long continued tendency toward loose bowel function, but is probably also to be considered a minor

factor in her case. It may, however, have played a more important role than we can estimate in the production of the explosive diarrhea, although this must be balanced off against diarrhea produced from the achylia and a break in pancreatic efficiency.

It is, however, most interesting to realize that it is possible to make this diagnosis of Giardiasis by duodenal tube study by recovering enormous numbers of the living flagellate. This parasitical disease is a far commoner occurrence in temperate climates than we formerly thought, and the diagnosis is often missed for two reasons: A, failure to routinely intubate the duodenum in gastrointestinal cases and B, to routinely examine the feces microscopically by proper differential stains. In regard to the latter, the living organisms are rarely recovered in the stools and the encysted forms frequently escape recognition in unstained specimens studied by an inexperienced observer. When stained with Donaldson's stain the vegetative forms as well as the cysts take on a bright canary-yellow color and can scarcely be missed. This stain is made up as follows:

1. Normal salt solution.
2. Saturated solution of iodine in 5 per cent potassium iodide in normal salt solution.
3. Saturated solution of eosin in normal salt solution.

This mixture will not keep, so for use two parts of solution 1, one part of solution 2, and two parts of solution 3 are mixed and dropped on the moist preparation.

GIARDIASIS.

Now, for a few moments it will be worth while to discuss the question of the *Giardia* infection in this patient's case. This parasitical infection shows always a great predilection for, if not an exclusive tendency to attack, the duodenum and jejunum. It is a condition that has been until very recently considered a rarity in temperate zones if one may judge from the literature. Until within the last five years there have been extremely few cases put on record, and the largest series, I believe, occurred within the personal observation of Dr. John C. Hemmeter, of Baltimore, who reported about 16 such cases. A smaller series had likewise been reported by Dr. Frank Smithies, of Chicago. It is unquestionable that this infection flourishes to a greater extent in tropical and subtropical countries, but its occurrence in temperate climates has been shown increased beyond our former beliefs as a larger number of men have become interested in the detection of the disease. The recognition of it has come chiefly from the finding of the encysted parasite in the stools, and there has been a very distinct failure to routinely seek for its

presence in its actively motile state in the duodenum. Its incidence may become larger if we extend our routine examinations of the duodenum to include a search for it.

In less than two years in Philadelphia I have recovered *living* *Giardia* from the duodena of 11 patients, only 1 of whom had ever been in a tropical or semitropical climate. Only 2 of these cases were affected with diarrhea, this case and another woman who had pulmonary and intestinal tuberculosis, and in both of these the diarrhea could therefore be explained on other grounds. Six of the other 9 cases had obstinate constipation, and 3 had normal bowel function.

Within recent years it has been proved that the *Giardia* may infest other mucous surfaces beside the duodenum and jejunum, since Smithies and, I believe, Hemmeter have reported its recovery from the gall-bladder at operation. Their finding in the gall-bladder, therefore, argues very strongly for the possibility of ascending infections of the common duct and gall-bladder by direct extension from the duodenum, since obviously these parasites are not likely to have been carried to the gall-bladder by way of the blood stream.

In reviewing the recent literature on the subject it was found that with one exception (11) the diagnosis of Giardiasis was based on the discovery of cysts, and at times free forms of this organism, in the stools.

The question of the classification of this flagellate is still an open one. Noc (12) disagrees with Benson's division into special types in man, mouse and rabbit, based on difference in size of organism and form of "third nucleus." Kofoed *et al.* (8) find that the morphology of the organism of trench diarrhea is the same as that found in the meadow mouse—the "Dachshund rat" of the trenches—and agrees with Porter that the species are transferable. Noc does not believe in the union of two organisms to form a cyst, but believes rather in a longitudinal division within the cyst, not limited to the formation of two organisms. Ledingham and Penfold (9) believe that there is little doubt that cyst formation is preceded by conjugation of two individuals.

The question of the pathogenicity of this organism is also unsettled. Still takes the extreme position that *Giardia intestinalis* is "responsible for a chronic and intractable diarrhea, an infection only minor in importance to amebic dysentery." Daniels and Baumpt agree with him that the flagellate is pathogenic. Emerson, Stiles, Rodenwaldt, McNeal and Neven-Lemaire think that it may prolong a preëxisting condition, whereas Brown, Park and Williams, Barker, Besson, Allbut and Rolleston, and other of the older writers state that it is non-pathogenic.

The whole question was revived during the Great War, principally due to the reported findings of this organism in troops invalided home, especially from Gallipoli, with symptoms of dysentery. In

136 consecutive cases of "dysentery," Kennedy and Rosenwarne (7) found 12 cases in which no organism other than the giardia could be found, although primary amoebic dysentery could be excluded (these cases had had emetin on their way home). Fantham and Porter (6) found 187 cases of pure giardiasis among 1305 patients, and in both human and animal giardiasis stool, and at postmortem found that erosion and distortion of the intestinal epithelial cells had occurred owing to the direct suckorial action of the flagellate. Logan and Sanford (10) found 66 cases in 6000 patients, mostly from the northern United States, in 4 of whom it was the only organism found that could account for the symptoms. From their studies they conclude that *Giardia intestinalis* is probably pathogenic and that there is no definite syndrome. Cade and Hollande (2) report on 10 cases under their care, the chief symptom being diarrhea generally of long duration with intermissions. *Giardia* is also found very frequently in association with other intestinal parasites, and Billings (1) warns that "the mere finding of the lamblia (*giardia*) does not prove that it is the sole cause." The clinician must, by a careful study, eliminate other diarrheal affections, in which its presence may be a mere coincidence and not of etiologic importance.

It was generally supposed that giardiasis was limited to tropical and subtropical climates, but with more careful examination it is becoming more evident that the distribution of the parasite must include temperate climates as well.

The most striking thing in a review of the literature is the fact that up to 1917 absolutely no successful method of treatment had been suggested. All the usual anthelmintics proved useless and emetin was of no avail. In a personal communication from Dr. Hemmeter, of Baltimore, and in a paper read before the American Gastroenterological Society in May, 1920, he states that he has treated several cases of Giardiasis by "mechanical washing out of the lamblia (*Giardia*) by progressively entering the upper bowel with the intestinal tube, farther and farther. As a vehicle I use Ringer's solution, weak solutions of methyl-blue or thymol." He also states that "compounds that liberate formaldehyde, like hippol in alkaline solution, and pass through the enteroportal circulation many times are effectual (most so in my last 3 cases) because this reabsorption and resecretion through the bile is kept up by the normal physiology a long time." All so-called cures must be examined in the light of the work of Porter (13) and Dobell and Low. (5) The former found that the number of cysts vary from day to day, and that the periodicity in maximum number of cysts was about fourteen days. The latter's study of a healthy man with a pure infection is most instructive. They examined the stool for a hundred consecutive

days, finding sixty-two negative sequences of nine, ten, and seven days. They then gave courses of bismuth salicylate, beta-naphthol, methylene-blue, turpentine, and guaiacol carbonate, but could show no run of consecutive negative days as long as during the untreated period, during and after treatment there being fifty consecutive positive days.

It was not until 1917 that Yakimoff *et al* (14) used arsphenamine in treating, experimentally, white mice infected with giardia. They used a 1 to 300 to 1 to 1000 solution, giving 1 cc per 20 grams body weight of mouse, finding that 1 to 1000 solution seemed to answer—no giardia being found in the intestines when mice were killed one to three months after infection.

Kofoed *et al.* (8) also used arsphenamine in rats, and found that + 4 to + 8 the human dose prorated to body weight of rat, freed the animal of Giardia, but that single doses, comparable to the human dose, had no effect; but they did not study repeated doses of this amount.

Carr and Chandler (4) report the use of neoarsphenamine in 1 case, in man, with relapse after one injection, but no relapse for five months after three subsequent injections of that drug. This use of arsphenamine seems to offer the best hope of curing the infection, but it will need more confirmation before it can be fully accepted. I have had success with the use of Dimol in 1 case.

The description of these parasites varies somewhat according to the authorities which one consults. For instance, Cammidge (3) states that they are from 5 to 12 microns broad, whereas Cade and Hollande (2) state that they are from 10 to 13 microns long by 8 to 9 microns wide. While I have made no attempt to accurately measure these parasites in the 11 cases in which I have found them in the living forms, yet they have seemed to average about 12 to 20 microns in length by 8 to 12 microns in breadth. In shape the parasite on its flat surface has been described as being pear-shaped, but there are certain ones which I have seen which resemble much more the shape of a racquet, being somewhat more oval than pear-shaped.

As to its further description, let me quote from Cammidge, who says: "The parasite is pear-shaped, and is from 10 to 21 microns long, and 5 to 12 broad. In its anterior portion is a more or less well-marked depression, which constitutes the peristome or mouth opening of the organism. It is provided with eight flagella grouped in pairs. The first pair are situated on the sides of the peristome and are directed backward. The second and third pairs arise at the projection at the inferior end of the peristome, and likewise project backward. The fourth pair issue from the tapering tail-end of the



FIG. 161.—Somewhat schematic sketch of *Giardia* under magnification with oil immersion, showing the eight flagellæ, the peristome or sucker-like mouth, the dumb-bell shaped nucleus, and the granular protoplasm, and several of the encysted forms found in the stools.



X 385

FIG. 162.—Giardiasis (Lambliasis) Intestinalis, with pancreatic insufficiency. A, young vegetative remains resembling distoma ovum; B, yeast; C, soap crystal; D, fatty acid crystals; E, encysted form of giardia; F, vegetative frame work; G, unstriated meat fibers; H, nuclear remains; I, cellular remains of young peas; J, striated meat fibers, partially digested. (From patient discussed in this Chapter.)

body. In fresh specimens the third and fourth pairs are frequently agglutinated and cannot separately be made out. In specimens killed with perchloride of mercury they can usually be differentiated. All the flagella are about equal length, and measure from 9 to 14 microns. The protoplasm is hyaline and finely granular. The organism is surrounded by a fine-cell membrane, which can be readily seen in fixed specimens. The nucleus is dumb-bell shaped, and lies at the base of the peristome. Vacuoles and solid inclusions are absent, nutrition taking place by osmosis. The parasites live in the duodenum and jejunum, adhering to the epithelial cells with its peristome. When they reach the large intestine they become encysted, and are then seen as round or oval bodies, measuring 10 to 14 by 8 to 10 microns, surrounded by a very distinct membrane, within which lies the folded organism. This is the form usually found in the feces, and unless there is severe diarrhea or the patient is well purged with salines, the motile parasite does not appear. Fresh specimens examined on a warm stage exhibit rapid but irregular movements."

This description is a very excellent one, but represents their examination by oil immersion lens up to 1500 magnification. This magnification is not a practical one to be used in fresh specimens obtained from the duodenum. They can be readily recognized under low power and the flagellæ can very distinctly be seen under high power with a dry lens. They usually occur in enormous numbers in strands of mucus, and the majority of them are seen in their lateral aspect where they look very much like the profile of the bowl of a spoon with a little projection backward at the base. From certain angles they also resemble in general the shape of a sickle. They are decidedly translucent, and of rather a shiny silvery gray, with a tendency to bluish refractibility. The *Giardia* do not ever appear to be stained by the bile. In the fresh unstained preparation it is not possible to make out the dumb-bell like nucleus in the peristome nor to demonstrate any granules. The flagellæ move very actively, and the second, third and fourth pairs can be most distinctly seen. The second and third pairs appear most visible when the parasite is lying on its side. Owing to the sucker-like action of the peristome it is quite easy to see why they can cling closely to the mucosa, perhaps being attached to individual duodenal cells, and, for this reason, why it is so difficult to dislodge them.

In the fresh living state they are quite motile and retain their active movement for hours if kept in a moist state on a warm stage. They move chiefly in a curious gyrating tumbling fashion, and sometimes whirl rapidly like a spinning wheel. They do not move far in any one direction nor very rapidly even when their progress is unimpeded by mucus or other débris. (See Fig. 163.)

To return to the case under discussion. The Giardiasis may possibly have contributed to the apparent pallor and cachectic appearance of this patient; yet this was not the pallor of anemia because the blood counts were relatively normal.

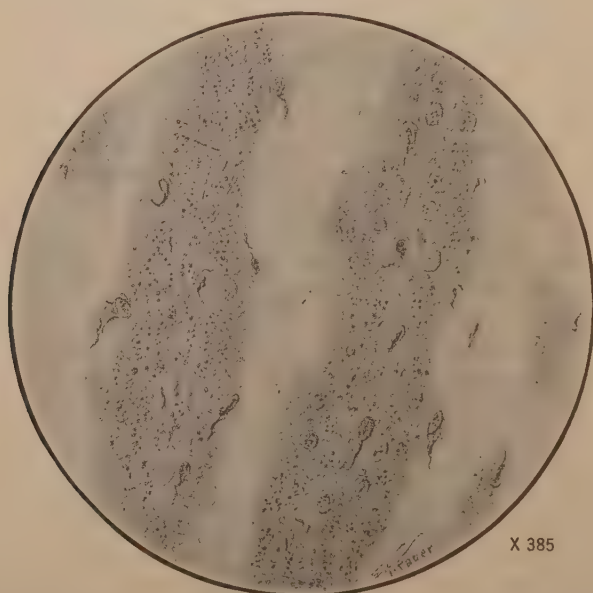


FIG. 163.—This drawing represents much more accurately the appearance of this parasite under the magnification customarily most adaptable to their recognition in the living vegetative state. Note the irregularity in shape and appearance depending upon the aspect from which they are viewed; the difficulty in visualizing, as a rule, more than 2 or 3 of the flagellæ; the tendency to adhere to band-like exfoliative masses of duodenal cells.

This completes a review of the provisional major diagnostic possibilities that this case presented on the basis of the history, physical findings and certain of the laboratory studies.

We have, however, still to consider four other possible minor or contributory factors. The historical note of twenty-six years of marriage and no conceptions would make a knowledge of the blood serology important. The blood Wassermann, however, was found to be negative and there seemed to be no clinical suggestion to warrant lumbar puncture and examination of the spinal fluid. The failure in securing a successful conception might be due to the retroverted uterus. We can therefore reasonably exclude syphilis.

The finding of large quantities of incorporated mucus in the feces, together with a moderate indicanuria and the intestinal motility study seems to indicate the presence of a mixed intestinal

toxemia, partly a pyogenic infection and partly a putrefactive toxemia of the indolic type with indicanuria. The increased belching and passing of gas with relief fits in well with both the gall-stone picture and the intestinal toxemia.

The nervous system is certainly partially exhausted by eighteen months' illness and we find this patient nervous and fidgety, with increased deep reflexes and a disturbed sleep picture of recurring "horrid nightmares" and involuntary twitching, although when she does sleep she wakens feeling refreshed. These disturbed sleep states will often be found associated with hepatic and intestinal toxemias.

The blood count is not particularly helpful except to rule out a real anemia; it reveals a leucopenia and a relatively high lymphocytosis which is suggestive of chronic focal infection with diminished resistance.

The cardiovascular, pulmonary, endocrine and osseous systems do not appear to be disturbed sufficiently to produce any contributory factor in the case.

We can now build up our total diagnosis and arrange them as of major or minor importance as follows:

Diagnoses.—*Major.*—Intra-abdominal cancer (if present probably involving gall-bladder) *vs.* gall stones, together with a disseminated infection of the gastro-intestinal tract (atrophic gastritis, cholecystodochitis, ileocolitis and chronic appendicitis). The negative transmission of the tuning fork note suggests no adhesions involving the pyloro-duodenum and the gall-tract.

Minor.—Giardiasis. Chronic pancreatitis. Intestinal toxemia and secondary disturbance of the nervous system.

Having completed our diagnostic survey, the next step is to determine what plan of treatment best suits the needs of this individual case, and here lies the value of securing, by a thorough preliminary study, as much available diagnostic data as is possible, so that we may apply the knowledge thus secured to laying out a plan of management which will be comprehensive enough to successfully meet or control the various states of disease or of disturbed function.

The immediate decision in regard to this case under discussion is comparatively easy, for we have satisfied ourselves that we have to deal with a proved case of gall stones, with a possibility of malignant degeneration of the gall-bladder. Therefore, under these circumstances, there seemed no question as to the advisability of this patient's undergoing an early laparotomy. In view of the possibility of cancer we should probably wish to follow this

course even though there had been certain definite surgical contraindications that might increase the surgical risk. In this case, however, such contraindications were not present. But we have to remember that after proper surgery has done its part we have still to make our plans to correct so far as may be possible the associated disseminated infections of the gastro-intestinal tract, as well as the direct treatment of the Giardiasis and the intestinal toxemia. Although, by the diagnostic biliary drainage, I recognized the fact that in addition to gall stones this patient had also a duct catarrh and perhaps an hepatic toxemia, in view of the cancer possibility it did not seem wise to give this patient a preliminary period of medical drainage to better prepare the operative field and to lessen the surgical and anesthetic shock.

It took just seven days to complete this patient's diagnostic study, and after a surgical consultation there was an unavoidable delay of two weeks before this patient came to operation. This however is not an unreasonable length of time for a case presenting certain very definite diagnostic difficulties. It is only to be regretted that many cases of this type wait so many months before having a thorough study and appraisal of their case. It would certainly have been better for this patient if the nature of her disease could have been recognized before she had suffered a weight loss of 40 pounds.

The final proof of the accuracy in diagnosis for certain diseases can only be furnished by a surgical examination into living pathology or by a later postmortem study. Let us now turn to a consideration of the operative findings.

Operation.—February 14, 1922. Dr. John Gibbon. Ether anesthesia.

An 8-inch upper right rectus incision. Gall-bladder exposed and found to be long, sausage shape and full of small stones. There were *no* adhesions involving the gall-bladder with the duodenum or stomach. The stomach was entirely negative to external examination. The pylorus was spasmodically contracted (notwithstanding the achylia), but relaxed under manipulation. The omentum was found extensively adherent to the anterior abdominal wall (which probably produced the ill-defined sense of epigastric mass). It was impossible to examine the pelvic viscera due to adhesions in association with peri-appendiceal bands. There were also adhesions between the upper surface of the liver and the diaphragm indicating a preëxistent peri-hepatitis. The appendix was removed and the gall-bladder was removed. A small anomalous duct in the gall-bladder bed discharged bile. This was caught and tied. The abdomen was closed in three layers without drainage. The usual immediate postoperative measures were instituted.

On removal the gall-bladder was found to be 10 cm. long and about 3 cm. in diameter. The serous surface was glistening and the walls were very thin and atrophic. The stones could be readily seen through the wall. The gall-bladder wall was punctured with the sterile needle of a hypodermic syringe and 2 cc of bile was transferred to a flask containing 100 cc of Huntton's glucose broth, and the culture promptly sent to Dr. Kolmer.

A drop of bile oozing through the puncture point was immediately examined and was found to be loaded with crystals of cholesterin and bile pigment. The cholesterin plates were all small and were identically like those seen in the preoperative diagnostic biliary drainage. Likewise, there were occasional isolated tall columnar bile-stained epithelial cells of the identical type as those seen in the preoperative study. (It is to be noted that the walls of this

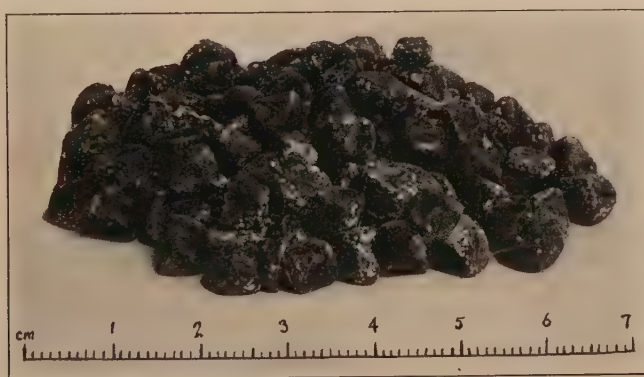


FIG. 164

gall-bladder were paper thin. The mucosa was doubtless in a state of nearly complete atrophy—therefore it is natural that our tall columnar epithelium preoperatively seen was quantitatively in the amount of only a plus 1. Where we see fan-shaped masses and rosettes containing 50 to 100 tall columnar cells compactly enmassed, I think we can infer that we are dealing with an earlier stage of mucosal cholecystitis and that the walls of the gall-bladder may be hypertrophied and perhaps edematous.)

The neck of the gall-bladder was then opened and the stones and bile expressed. The latter was very thick and mucoid, almost gelatinous, and was of the general shade of green-brown bile (only a trifle darker than that preoperatively secured) and identified as the "B" fraction. The microscopy of this bile was the same as noted above. No *Giardia* were seen. The mucous membrane was excessively thin and atrophic and moderate scraping with a blunt

scissors edge removed only a small amount of typical tall columnar bile-stained epithelium.

The Examination of the Stones. There were 155 facettèd stones, small but practically uniform in size, being about that of a small June pea (see Fig. 164). They were fairly firm, but could, with some difficulty, be crushed between thumb and forefinger. On section with a sharp knife they were found to be lamellated, having a rather whitish hard shell, a yellower and softer medulla, and a dark brown-black core or nucleus. When powdered and examined microscopically in a moist preparation this nucleus shows a preponderance of bile pigment crystals; the middle zone a preponderance of cholesterin; and the outer shell a mixture of cholesterin and the smaller crystals, which we could not identify, but were noted on the drainage sheet.

Several of these stones were sent to Prof. Hawk's department for chemical analysis, and several others to Dr. Kolmer for culture of the core or nucleus.

Dr. Lichtenthæler later submitted the following report on the chemistry of the stones.

REPORT OF ANALYSIS OF GALL STONES. (RECEIVED FROM DR. LYON.)

Description. Ordinary mottled yellow-brown color. Shape, rough polyhedrons, marked facettèd sides and dull to polished surfaces.

On section, outer shell found to be $1\frac{1}{2}$ to 2 mm. in thickness; soft and waxy, easily broken (not brittle), and of mottled brown to yellow color. This shell is composed of thin lamina (about 0.8 to 1 mm. thickness for the whole shell) and concentric with an irregular nucleus, about $1\frac{1}{2}$ to 3 mm. in diameter.

This nucleus is dark reddish-purple to black, and shiny on freshly fractured surfaces. It is irregular in form, being composed of aggregates of small particles, 1 mm. or less in diameter. It is brittle, friable, and fairly hard. (Apparently a pigment concretion.) There is no apparent lamination or concentric structure in these aggregate particles, and they have conchoidal fracture.

Outer shell, ground in mortar, formed golden-yellow powder (waxy, like hard wax, causing powder to cake on hard pressure). Nucleus, ground in mortar, formed fine, fairly dark green powder.

The shell and nucleus are proportioned as follows:

	Three stones (grams).	One stone (grams) Ave.	Per cent.
Weight of outer shell . . .	.3160	.1053	91.0
Weight of nucleus . . .	.0300	.0100	9.0
Total weight . . .	.3460	.1153	100.0

QUANTITATIVE COMPOSITION.

Composition.	Nucleus, per cent.	Shell, per cent.
Cholesterol	4.7	93.4
Calcium	8.0	0.5
Bilirubin	20.0	1.8
Biliverdin	44.5	1.5
Bilihumin	22.8	2.8
	100.0	100.0

Dr. Kolmer later reported as follows on the cultures from the gall-bladder and stones.

January 26, 1922. "B" fraction (by non-surgical drainage): *Staphylococcus aureus*; non-hemolytic streptococcus.

February 14, 1922. Bile from gall-bladder (operatively secured): *Staphylococcus aureus*; non-hemolytic streptococcus.

February 28, 1922. From nucleus of gall-stones: *Staphylococcus aureus*; non-hemolytic streptococcus; *B. coli*.

From the review of this case it will be seen that the diagnostic data preoperatively secured by non-surgical drainage are later proved to have been uncannily accurate.

This case has been presented in detail because it presents an unusual number of diagnostic possibilities, many of which overlap and their true significance can be estimated only by careful and systematic diagnostic study. I have many other cases of equal interest which could have been selected for the purpose of illustrating the general methods of diagnosis of gastro-intestinal disease which are today within our reach. It is rarely possible, however, to utilize any single case to illustrate all of the various accepted diagnostic maneuvers. To any doctor engaged in this character of work there comes, by a constantly growing experience, a knowledge of which diagnostic steps or tests will prove of paramount importance in the study of an individual case, and those which will be of less importance, and those which probably will throw no additional light upon this case, but may be of vital importance in another.

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CHAPTER XXIII.

THE SELECTION OF CASES FOR TREATMENT BY THIS METHOD.

IN the several chapters immediately preceding I have presented the fundamental principles upon which this method rests of more intimately and thoroughly approaching the diagnosis of gall-tract and other closely allied problems; I have attempted to establish the soundness of the principles involved and I have tried to outline the various steps necessary in the making of more accurate diagnoses. In this latter connection I have made an effort to emphasize the importance of the fundamental value of a properly taken anamnesis and a properly and thoroughly conducted physical examination; to emphasize the importance of collecting as much additional data as can be secured by our methods of diagnosis in which are included the usual routine analysis of the stomach contents and the stools; of the blood in relation to its volume, its cellular content, its serology and its chemistry; of the respiratory and oral secretions including the saliva; the need in certain cases of adding a study of the spinal fluid, and of the allergy reactions to various foods, to animal and plant emanations and to bacterial bodies; and to show the advisability in such detailed diagnosis of adding studies into the vital capacity or functional ability of the vital organs by the use of such functional and metabolic tests as are now sufficiently standardized to admit of reasonable reliability; and finally to emphasize the help that can be furnished by roentgen-ray plate work and fluoroscopic methods, which is one of our most important indirect aids in diagnosis.

Without attempting to minimize the importance of these methods of building up the diagnosis around the history and physical examination, I have, in the preceding chapters, tried to point out the great additional help in diagnosis that can be secured by a direct study of the bile as it is recovered by a duodeno-biliary tract drainage, and I have emphasized the diagnostic inferences which can be secured by directly studying the cytology, bacteriology and the physiological chemistry of the fluids obtained, and to show that by such direct examination we can more perfectly and reliably establish the diagnosis of gall-tract disease, in certain cases, than by any other single method.

Having thoroughly studied our patient and having established the one or more major diagnoses, as well as the several collateral, contributory or minor diagnoses, we should have gained a much more adequate idea of the nature of the disease or diseases which we have to treat. If I have laid so much insistence upon the need of collecting all the diagnostic evidence that is available it has been for the purpose of utilizing this data for a more intelligent and comprehensive method of management or treatment of the patient, in the hope that, by so doing, we can regain for him a greater measure of health. I therefore propose to discuss in this and succeeding chapters the usefulness of *this method of treatment either alone or in combination with other procedures both medical and surgical.*

The first requisite is to learn by experience the types of cases which can be successfully treated by non-surgical biliary tract drainage and those cases which cannot and should not be so treated until after they have been referred for operation. In a general way the majority of all cases can be divided into several groups, in so far as the beginnings of their treatment is concerned. They are:

(a) Cases who imperatively require surgery and who have relatively unimportant or no surgical contraindications.

(b) Those cases that might unquestionably be considered surgical, but in whom there are such serious contraindications as not to justify the surgical and anesthetic risk *if* non-surgical drainage can be shown to be an adequate alternative method.

(c) Border line cases formerly considered surgical, but who now might do as well or better by medical drainage of the gall-tract.

(d) Early cases for whom surgery is no longer indicated since similar cases have made satisfactory recoveries by medical drainage.

(e) Genuinely surgical cases to be *preceded* by preliminary medical drainage.

(f) Genuinely surgical cases to be *followed* by medical drainage.

(g) Essentially medical cases.

1. Catarrhal jaundice.

2. Arthritis.

3. Typhoid carriers.

Group A.—Cases Who Imperatively Require Surgery and Who have Relatively Unimportant or no Surgical Contraindications.—Having completed a diagnostic drainage or several of them if necessary, we must first decide whether the case is emphatically and unquestionably surgical and nothing else, which means that there should be no unreasonable surgical contraindications present. Into such a group fall all cases of *restive* gall stones, who are having frequent or severe attacks of biliary colic.

In this connection we should bear in mind that the presence of

gall stones should be definitely ascertained, as occurs in those cases in whom unquestioned gall-stone shadows appear on the roentgen-ray plates, or in those cases negative by roentgen ray, but in whom the cytological findings and the crystalline precipitations from the bile are strongly suggestive of calculi and fit in closely with the general clinical impression of the case.

We should also bear in mind that there are certain cases in whom there is historically strong grounds for believing that the biliary colic is due to stones, but in whom at operation no stones are found nor have they ever been recovered from the sieved stools following the attack. We have learned that occasionally, perhaps more frequently than we realize, such a clinical picture of gall-stone colic can be simulated by some physiological or pathological alteration in Meltzer's antagonistic innervation of the gall-tract whereby there occurs simultaneous contraction of an inflamed gall-bladder acting against a tonically contracted Oddi's sphincter. This may produce a rise in intraduct tension capable of creating intense colicky pain when the ducts or gall-bladder or both are acutely inflamed and perhaps partially choked up by catarrhal swelling or inflammatory edema. (See Report of Case XXIII.)

Are quiescent gall stones a clear indication for surgery? This brings us on debatable ground. Kehr has estimated that 1 out of every 10 adult persons has gall stones at some period of their lives, but that only 5 per cent of this very large number of gall-stone cases develop biliary colic. Other statistics have been gathered together by many writers which substantiate the great frequency of gall-stone formation, but which occur in patients who do not have colic and often have the most meagre clinical evidence to suggest their presence. That this is true is proved in the frequent finding of unsuspected or quiescent large gall stones in patients operated upon for other intra-abdominal diseases, notably in the field of gynecology, or gall stones which are discovered at autopsy in patients in whom during life there was no clinical reason for believing them to be gall-stone sufferers. The smaller the stones, in the presence of inflammation and infection in the gall-bladder, the more apt are they to become restive.

Some surgeons take the view that it is safer to operate upon all such stone cases on the ground that between 5 and 10 per cent of all gall-stone cases so operated have shown coincident cancer of the gall-bladder produced presumably by stone irritation and that by operatively removing the stones the cancer risk is avoided. Such reasoning might be logical, and particularly so if we were only able to tell in advance which 5 to 10 cases would develop cancer and which 90 to 95 out of each 100 cases would not. But when we consider that the operative mortality risk, *when averaged*

throughout the country, is also between 5 and 10 per cent, if such a plan were carried out on all gall-stone carriers in order to avoid a cancer death, the cure would be as bad as the disease. Furthermore, if the gall-stone factor in producing gall-bladder cancer is to be considered so great, it might be pertinent to ask ourselves why it is that of the large numbers of gall-stone carriers who are not operated upon so few of them develop gall-bladder cancer or die a cancer death.

In a number of *quiescent* gall-stone cases there may be inflammation and infection within the ducts and even within the gall-bladder producing vague clinical symptoms of mild nausea, mild epigastric and right hypochondriac distress with or without belching, but in whom the inflammatory and infected state is so early or of such low grade as not to make the gall-bladder irritable and the gall stones restive. In certain such cases I have found it possible by medical drainage of the gall-tract to remove all evidence of the catarrh and infection and bring such patients back to a clinically perfect and symptomless state of health. (See Report of Case XX.) Whether this will prove to be a good practice in properly selected patients I believe cannot be honestly decided upon until sufficient time has elapsed, but where the patient is old and feeble and with a life expectancy of but a few years perhaps such a plan of procedure will prove to be justifiable rather than to assume the increased surgical risk in such a patient. Indeed I believe that the case to which you are referred was suffering not so much from her gall stones as from an hepatic and intestinal toxemia which could be successfully relieved by biliary drainage and transduodenal lavage, and I question whether a more favorable result could have been accomplished surgically by the removal of her gall stones and gall-bladder with perhaps drainage of her common or hepatic duct. I have said that this is very debatable ground, and I believe that it is probably much wiser at present to consider all gall-stone cases (without emphatic surgical contraindications) as being primarily surgical, until the future has shown us more fully by practical experience with medical drainage that a reasonable series of such cases so treated will average as well as those who undergo the surgical risk.

For a moment now, let me digress from the discussion of cholelithiasis and turn to a brief consideration of a closely allied state of disease. Various surgeons and experimental workers have taught us the association of varying degrees of *pancreatitis* which exist in the presence of gall-tract disease. It has become a common occurrence for the surgeon operating upon cases of cholecystitis or of cholelithiasis to find the head of the pancreas sometimes swollen and enlarged and at other times of normal size or even smaller than

usual, but in most instances, where chronic pancreatitis exists, in a state of increased hardness to digital examination. It seems unlikely that this is a purely coincidental double disease, but more likely a question of cause and effect. In such patients who have come to necropsy this hardness of the pancreas has usually been found due to an interstitial pancreatitis with inter- or intra-acinar fibrosis.

It has been considered by Deaver, Pfeiffer and others that the pancreas becomes infected secondarily as a result of a primary gall-bladder infection travelling to the pancreas by way of the lymphatics, and that the pancreatitis is a result of such infection. It has been hoped and surgically believed that as an accompaniment of draining the gall-bladder the pancreas is also drained, by way of its external secretions, with a resultant lessening of its infection. Clinically, there is a very good amount of evidence to support this point of view, although the actual necropsy proof has not been adequately or definitely supplied.

It is probable, too, that pancreatitis of various degrees can be produced by pancreatic duct catarrhs without infection and may come about as a result of a blocking of the major pancreatic duct in association with an obstructed common duct due to catarrhal jaundice, impacted gall stones, or by pressure from neighborhood new growth, in which the external pancreatic secretion is partially or wholly retained. This may give rise to an increase in intra-pancreatic tension which by its pressure effects may so damage the pancreatic cells as to create a pancreatic cirrhosis, just as a state of biliary cirrhosis may be produced by a complete obstruction of the common bile duct existent over a long period. (See Fig. 118.)

Again, it has been experimentally found by Opie, Archibald and others that pancreatitis can be produced by the entrance of bile into the pancreatic duct as a result of various anatomical, physiological or mechanical derangements (spur, spasm of Oddi's sphincter, impacted gall-stone, etc.), and it has been considered that the bile salts of the bile are most importantly concerned in the production of this form of pancreatitis. Acute pancreatitis has been thus experimentally produced by injecting bile into the major pancreatic duct.

If chronic pancreatitis is to be considered as improved by biliary tract drainage, this field of work has hitherto fallen exclusively into the realm of surgery, but it can be hopefully anticipated that many cases of pancreatitis, pancreatic insufficiency and perhaps other pancreatic diseases might be equally benefited by medical drainage of the gall-tract through the duodenal route. Indeed this would seem to be the more logical drainage route for such a condition inasmuch as the tip of our duodenal tube can be

placed in closer proximity to the pancreatic ducts than can a rubber tube when introduced into the gall-bladder.

The surgeon will naturally ask by what means we would diagnose a case of chronic pancreatitis, coexistent with gall-tract disease, when the internist is deprived of the direct examination of the pancreas by surgical exploration and visualization. But what diagnostic advantage does the surgeon gain by such exploration? In most cases it simply affords the opportunity to palpate the head of the pancreas between the thumb and forefinger and to determine its relative size and its hardness and the presence of enlarged lymph nodes. If it is abnormally large and hard, or abnormally small and hard, and even of normal size but hard, this is believed by many surgeons to be direct diagnostic evidence of pancreatitis. Herein lies an error of personal equation. A certain pancreas to the inexperienced surgeon might seem hard, but to the experienced surgeon perfectly normal and *vice versa*. We know that such a difference of opinion between the surgeon and his first assistant frequently occurs at the operating table.

In all other respects save in visual and digital examination of the pancreas the internist enjoys an equal advantage with the surgeon in the diagnosis of chronic pancreatitis. Both may make use of the Cammidge test of the urine, now generally considered of doubtful value, although this may be due to a non-adherence to the originator's method of technic. The diagnostic help in estimating pancreatic deficiency of function by testing out the pancreatic enzymes from duodenal and biliary fluids, and the chemical and microscopical study of the stools for indirect evidence of pancreatic dysfunction are of much greater value when carefully and intelligently performed. Such diagnostic aids are equally available to the internist and to the surgeon, but it is probably nearer the truth when I say that the average well-trained internist makes more frequent and better use of such tests than does the average well-trained operating surgeon.

We have found that a total chemical achylia gastrica predisposes to the production of cholelithiasis rather than cholecystitis, but both of the latter predispose to chronic pancreatitis; and furthermore, that achylia gastrica of itself certainly predisposes to pancreatic insufficiency, if not actually to pancreatitis, by throwing a double digestive burden upon the pancreatic enzymes due to the absence of gastric juice, thus fatiguing and finally exhausting pancreatic cellular activity, so that we later have clinical evidence of pancreatic dysfunction producing certain group symptoms, among which diarrhea is conspicuous. Perhaps one reason why medical biliary drainage has proved so beneficial in such group pictures may be because we are draining the pancreas as well as the gall-tract (liver, gall-bladder and ducts). (See Report of Case XLI.)

There is one type of pancreatitis or predisposition to pancreatitis which is primarily and strictly surgical, and that is the type produced by an impacted common duct stone often showing ball-valve tendencies. Such cases are definitely mechanical and require surgical relief. Even in this group, however, I have been able to show in several instances the advantages of a preoperative period of transduodenal lavage and of medical biliary drainage. (See Group E.)

In several cases of gall-stones both in the gall-bladder and in the ducts it has been found possible to aid in their expulsion by douching the duodenum with hot solutions and the use of duodenal stimulations with magnesium sulphate. (See Report of Cases XII and XIII.) That this is true is no excuse for considering this good practice (perhaps with the exception of impacted ball-valve stones), although it has a certain diagnostic value in the way of direct proof, and I heartily condemn any such exploited use of medical biliary drainage in cases of restive gall stones on account of the grave danger of perforation of the cystic or common ducts, although this has fortunately not occurred in any of the cases among my personal records. It is conceivable that a case of solitary medium or small sized stone, as disclosed by roentgen ray, particularly if round and smooth, if made to pass through the ducts by medical drainage, might result in as satisfactory a cure as if this stone had been surgically removed.

In the event that stones are sieved out of the stool following medical drainage, and are found to be facettied, surely one would be most unwise in considering that there were not additional stones left behind and promptly refer such a patient to a capable upper abdominal surgeon. As I stated in the section on the direct diagnoses of cholelithiasis, it is well to remember that in any case in which medical drainage is followed by a severe attack of biliary colic or of pain which reproduces any of the pain attacks described in the history, the stools should be carefully washed through a sieve, a piece of gauze or a handkerchief for the recovery of possible stones. In a similar direct diagnostic way I have seen several cases in which there was a reproduction of acute biliary tract pain immediately or within a few hours following a medical drainage, and have learned that this too may occur in non-gall-stone cases who have acute cholecystitis, usually infected with the pyogenic groups of bacteria, and who, in addition, may have adhesions involving the gall-bladder. (See Report of Case XV.)

Turning now from the question of gall stones, before we can select certain of our cases who are unquestionably surgical and nothing else, we must carefully review, not only the general clinical evidence, but particularly the diagnostic medical drainage. If

by the latter we can prove that we can secure an efficient medical drainage of the entire gall-tract as evidenced by a satisfactory A, B, and C sequence, we are then in a position to offer an alternative plan of treatment for cholecystitis, choledochitis, cholangitis and, under certain circumstances, even for empyema. (See Report of Case XVIII.)

Most cases of *acute cholecystitis* are unquestionably surgical even though it can be proven by our diagnostic drainage that the gall-bladder can be effectively drained by magnesium sulphate through the duodenal route. In the selection of such cases for methods of treatment it is certainly wiser to consider them as being primarily surgical provided the surgeon is contemplating a cholecystectomy. If a cholecystostomy alone is being considered I am not so sure but that medical drainage would prove as effective in the immediate relief of symptoms and perhaps equally curative provided the cystic duct is patent and if the bacteria have not obtained lodgement within the gall-bladder wall.

If the patient is suffering from the first attack of cholecystitis and it is not very severe in its clinical aspects and the drainage findings culturally recover a staphylococcus or bacillus coli group, and the cytological picture does not reveal high grades of inflammatory evidence and exfoliation of highly necrotic gall-bladder epithelium, it might be perfectly safe, judging from rapidly accumulating experience, to treat such a patient by medical drainage. Indeed certain clinically severe cases with streptococcic infected gall-bladders have been successfully so managed and have remained well for two or more years.

Where we are dealing with streptococcal infections of great virulency and particularly where the cytological evidence shows an advanced stage of necrosis as though threatened with gangrene, it is unquestionably safer for this patient if his case is handled surgically, so that the gall-bladder may be resected before it has perforated or before too great plastic exudate has formed adhesions with neighborhood viscera (pyloro-duodenum, hepatic flexure of colon and gastro-colic omentum). If, however, in severe cholecystitis of all grades including empyema, the gall-bladder is not removed, surgery does not accomplish anything more, if as much, by drainage as can be secured by medical drainage through the duodenal route provided the cystic duct is proved patent. This is exemplified in report of Cases I and VIII.

In any cases of Group A, *if the cystic duct is obstructed* for any of the reasons detailed on page 331 and we find by our diagnostic drainage that we are not able to drain the gall-bladder, then obviously this non-surgical method is no longer an alternative choice and surgery must be resorted to. This, however, holds true only

in the very acutely ill person in whom delay in surgically establishing drainage might prove dangerous or fatal, for I have occasionally seen a case of this severe type who has made a satisfactory recovery by medical drainage. (See Report of Case XXII.)

In the early stages of acute cholecystitis where the pathological-cytological picture is not very severe and in the older chronic but well established cases of cholecystitis in which the establishment of prompt drainage is not such a life-saving necessity, the finding of an obstructed cystic duct on the first diagnostic drainage does *not* in my judgment, imperatively indicate immediate surgery. Here one can safely repeat the procedure of medical drainage several times before finally having to realize that this particular case lies beyond the scope of this method. I say this because I have seen many instances in which the cystic duct has been found obstructed by inflammatory edema and a catarrhal process within the duct and in which, by repeating the medical drainage daily or at frequent intervals, the catarrhal flocculent particles have been gradually forced out of the ducts and the inflammatory edema has subsided. (See Report of Case XXV.)

Indeed, if patient microscopical study is made of these floccules at each successive drainage we can almost literally watch, step by step, the gradual unblocking of the duct. If some cytological evidence that this is taking place cannot be shown after four or five such medical drainages it is probable that we are dealing with a cystic duct obstruction due to adhesions, impacted stone, enlarged lymphatic gland or pressure from neighborhood new growth or from atresia of the duct, and such cases again become unquestionably surgical and nothing else.

There is still another group of cases in whom we are unable to recover any recognizable "B" bile and from this may have reason to suspect that the cystic duct is obstructed, but in whom we fail to recover any positive cytological evidence suggesting cystic duct obstruction due to catarrh or infection with inflammatory edema, and who at subsequent drainages may suddenly show a more normal gall-bladder response. These cases obviously cannot have a mechanical cystic duct obstruction and we have reason to suspect that they primarily fail to drain due to some defect in the neuromuscular mechanism of the gall-bladder and ducts. This condition Smithies very aptly describes by applying the term "physiologic block" as contrasted to the other type of mechanical block. I cannot do better than to quote at some length Smithies' diagnostic conception of this condition.*

"We have selected the term 'physiologic block' to describe the

* Smithies, Karshner and Oleson: Jour. Am. Med. Assn., December 24, 1921, No. 26, vol. 77.

phenomena exhibited when the normal neuro-muscular reflex concerned in bile excretion fails to function. Our meaning may be made evident by analogy. An injury to or disease of the brain, an acute psychic shock, trauma to the spinal cord by accident or ailment, or local pathological or mechanical abnormalities of the urinary bladder may result in pronounced dysfunction of that viscus; there occurs incontinence or retention, accordingly as voluntary or involuntary neuro-muscular pathways are disturbed. We feel strongly that similar breaks occur, at times, in the neuro-muscular reflexes of the biliary tract and the liver. Because such reflexes are concerned with the autonomic nervous system and are not voluntary their importance and significance are no less. In the event of 'physiologic block,' even though the bile passages are not obstructed by calculi, adhesions, twists or kinks, intraduodenal stimulus by magnesium sulphate solutions or other agents cannot be expected to excite normal physiological response. Consequently, difficulties are experienced in securing gall-bladder specimens when patients are under anesthesia or when subjects are fatigued or in dread of the procedure. Our records show this in striking fashion, particularly in respect to excitable, apprehensive Latin-Americans or psychically hyperplastic Hebrews. Of the latter class, we encountered defective response in 50 per cent of the females and in 35 per cent of the males when, in a consecutive series, other groups of patients exhibited defective response in 17.8 per cent of women and 18.3 per cent of men (140 and 120 subjects, respectively).

"Organic cord lesions (tabes, tuberculosis, tremor) similarly interfered with our aspirations. We had difficulties with certain patients in whom organic lesions of the stomach and the duodenum were present. In the gall-tract and the liver, there exist many opportunities for local breaks or uncoordinated response to the normal neuro-muscular reflexes. Disease at the papilla of Vater, in the walls of the common and hepatic ducts, in the gall-bladder and possibly in the liver itself is productive of such gross or microscopical evidences of destruction that one cannot fail to appreciate hindrances to normal function, particularly muscular activity. Thus, it follows that a gall-tract, especially a gall-bladder, may harbor no obstructive lesion and yet even frequent attempts to stimulate its emptying by magnesium sulphate solutions or other agents fail. But if these phenomena are observed and are correlated with physical examinations and clinical histories, they certainly are of significance. The psychically unstable subject may respond normally after repeated seances; the feebly contracting musculature of an infected gall-bladder or bile duct may empty at later sessions, particularly when static, thick or overdistending bile accumulations have been

removed; a bile-engorged, enlarged liver shrinks beneath the costal arch. When there has occurred extensive destruction of bile-tract musculature, even though ducts are freely patent, our observations show that magnesium sulphate or other agents intraduodenally introduced have little or no effect in promoting bile flow. Frequently enough have we seen distended gall-bladders and ducts with paper-thin walls devoid of muscle bundles, or fibrosed gall-bladders and ducts, in which, in no circumstances, could one expect neuro-muscular response to stimuli to occur: both muscle and nerve terminal mechanism are absent, there is 'physiologic block.' This form of 'block' undoubtedly accounts for many failures in biliary tract aspiration in the face of non-obstructing lesions; and unless its possibility is considered and the patient studied at several sessions, the Meltzer-Lyon method will receive unwarranted criticism; the method would seem to be not at fault; rather the interpretation of the results of its application."

My personal observations very closely parallel those of Smithies as expressed above, and it will be seen that our failure at times to recover gall-bladder bile in certain cases of atony of the gall-bladder can be best explained on this hypothesis of "physiologic block." (See Report of Case XI-A.)

Group B.—Those Cases that Might Unquestionably be Considered Surgical, but in Whom There Are Such Serious Contraindications as Not to Justify the Surgical and Anesthetic Risk if Non-surgical Drainage Can be Shown to be an Adequate Alternative Method.—Into this group fall practically all of the types of cases represented in Group A (except cystic duct obstructions), for whom surgery would be unquestionably and imperatively indicated if it were not for the fact that they present such serious contraindications as not to justify the surgical and anesthetic risk if medical drainage can be shown to be an adequate alternative method. Among the graver surgical contraindications can be included cases of severe myocarditis, nephritis or decompensated cardio-renal disease, hepatic cirrhosis, diabetes, toxic hyperthyroidism, gall-tract disease complicating acute infectious fevers, such as typhoid cholecystitis, pernicious or grave secondary anemias, severe types of hemolytic jaundice with splenomegaly, the asthenic visceroptotics with biliary stasis and gall-tract infection, and finally, empyema in the aged or very feeble patient. None of these is a good operative risk, yet heretofore nothing of practical value other than surgery could be done for them. I have had some experience with each of these groups and in some have scored some very remarkable and permanent successes (five years) and in others have so improved the previous surgical contraindication as to permit them subsequently to be successfully operated upon with as yet no mortality. Practi-

cally everyone of these patients has been improved by medical drainage, some markedly so; none of them have died as a direct result of the procedure, although probably a very large percent of them would have succumbed to the surgical and anesthetic shock. (See Report of Cases VII, XIX, XX, XXI, and XXII.)

Group C.—Border Line Cases Formerly Considered Surgical, but who now Might do as Well or Better by Medical Drainage of the Gall-tract.—

Into this group of border line cases, formerly considered surgical, but who we now have learned will do as well or better by medical drainage of the gall-tract, fall all that large number of patients who present various clinical, but almost always vague historical pictures with atypical digestive symptomatology, formerly masquerading under the terms of functional dyspepsias, nervous indigestions, biliousness, and chronic appendicitis (a diagnostic term much too frequently and lightly applied) who have been persistently dieted and ineffectually drugged for many months or years.

It is this group, as well as Group D, which require careful and comprehensive study by all of the means suggested in preceding chapters, and frequently in whom the direct diagnosis of a masked or unsuspected infection or catarrh of the gall-tract is disclosed only by a diagnostic drainage.

Heretofore many of this group, after having passed unimproved through many doctor's hands, finally agree to submit to exploratory laparotomy and the surgeon finds nothing in the way of visible pathology in the upper right quadrant, with perhaps the exception of some minor adhesions, and contents himself with the removal of a relatively normal appendix or a so-called Jackson's veil or membrane, and perhaps fixes an abnormally mobile cecum, to which conditions he often erroneously attributes all of the patient's trouble and unsuspectingly leaves behind an infected gall-tract.

It is only a too common story to learn from such patients that they improved not at all or that their improvement lasted but a few weeks or months after such surgical procedure before they relapsed back to their former state of chronic indigestion with perhaps a gradual development of more significant symptoms directing attention to the upper right quadrant.

A very large series of patients in this group have, in my experience, made brilliant recoveries with a complete restoration to health in proportion to the diagnostic recognition of the collateral or contributory minor diagnoses. By this I mean that many such patients have primary foci of infection in the oro-nasal cavity which must be searched for and eradicated, and they may have in addition to the gall-tract infection other disseminated catarrhal and infected states in the stomach, the small and large bowel, and especially the recto-sigmoid, all of which must be diagnostically recognized

and appropriately treated in conjunction with medical drainage of the gall-tract.

I feel quite positive now that such cases can be recognized and when recognized will make much better progress toward permanent recovery by topical medical treatment on a comprehensive plan rather than by surgery. It is just such injudicious surgery, often repeated through a series of three or more operations, which eventually leaves the patient a crippled abdominal invalid of the type so commonly seen in our gastro-intestinal clinics.

The surgical chronology of many such patients, as represented in their protocols, show the first operation for these atypical states of indigestion consisted in the removal of the appendix and a negative, though often merely digital, exploration of the upper right quadrant. A few months to a year or so elapses, and the patient is not improved and the second operation will often be for the release of adhesions at or around the cecum and the drainage or removal of a gall-bladder, which after the lapse of time and the latent but unrecognized infection, now shows visible pathology involving the gall-bladder. By this time, however, a surgical gall-bladder drainage or removal frequently does not eradicate the disease because the ducts have become infected and this residual infection produces again a surgical relapse, and at the third operation upper right quadrant postoperative or inflammatory adhesions are released and a choledochostomy performed. Nor does this always end the surgical necessities as many of my private and clinic protocols will show. Much of this state of affairs could be avoided if our cases were more thoroughly studied and more accurate total diagnoses made. (See Report of Cases XVI and XVII.)

The story, however, is by no means always one of diagnostic negligence on the part of the surgeon. Many cases falling within this group do have true appendicitis as well as gall-tract infection, but neither of these states are recognized by the physician and the patients are uselessly dieted and drugged and often criminally purged so that the appendix becomes gangrenous and perforated and brings the patient to a situation where only the skill of the surgeon can save his life. Twenty years ago there were many more such instances of this diagnostic lack of knowledge of appendicitis than is present today, because our surgical confrères have educated their medical brethern to an earlier recognition of appendiceal danger signals. I hope that twenty years hereafter, by proper application of similar methods of medical education, our physicians and surgeons of the next generation will have learned to make better use of the direct methods of diagnosis of the biliary tract and thus recognize the earlier beginnings of gall-tract disease.

Finally, many patients in this group and in Group D, who have

early but latent catarrh and infection in the gall-tract, have also a true but incipient appendicitis. In such patients in whom the clinical suggestiveness of a right lower quadrant lesion exists, especially when supplemented by a positive roentgen-ray diagnosis of appendicitis, the best procedure of choice is to first surgically remove the appendix and then postoperatively to institute medical drainage of the gall-tract, eradicate the primary foci and adopt measures for the appropriate topical treatment of the colon and the recto-sigmoid, supplemented by the use of autogenous vaccines.

Group D.—Early Cases for Whom Surgery is no Longer Indicated Since Similar Cases have Made Satisfactory Recoveries by Medical Drainage, Combined with Appropriate Medical Measures.—Into this classification fall another large group of patients in whom, by means of a medical diagnostic drainage we can demonstrate the earlier beginnings of gall-tract disease, chiefly gall-bladder and duct catarrhs and infections, in a more reliable manner than is possible by any other diagnostic method. Many of these cases represent the latent, masked or unsuspected infections of the gall-tract, perhaps in an even earlier stage than certain of those cases making up part of Group C, for the clinical symptoms are even more vague and nondescript. These cases formerly were entirely undiagnosable as early gall-tract disease on the basis of the historical evidence or the abdominal physical findings. For the history is always indefinite and frequently shows such variations as to suggest gastric neurosis combined with a total neurasthenic picture and the abdominal physical findings are almost invariably absolutely negative except possibly for splanchnoptosia. From a digestive standpoint these patients may complain of almost anything, but usually in a mild degree. The symptomatology occasionally may appear to mimic certain better recognized digestional entities, but a closely taken history, if keenly analyzed, will show certain discrepancies and the diagnosis of gall-tract disease can alone be made by a medical diagnostic biliary tract drainage which will show cytological evidence of catarrhal or infected states involving the gall-bladder or the gall ducts or both.

To anyone not personally familiar with the diagnostic possibilities of this method the foregoing statements will appear very far-fetched. Two medical generations ago, before the microscope came into more common use and the bacteriological methods of today were utterly unthought of except among the chosen and diligent few, it would doubtless seem as far-fetched if the earlier investigators into the microscopical, chemical and bacteriological study of the urine had stated that the finding of mucus shreds, pus cells, exfoliated epithelium and pathogenic culturable bacteria was very sufficient evidence for a diagnosis of catarrh, inflammation and infection

somewhere within the urinary tract. But today even the average doctor not only knows this, but can go further and differentiate between urethritis, cystitis and pyelitis. A medical generation hence, better trained in similar methods of diagnosis applied to the gall-tract, will wonder why so many of us in this generation failed to appreciate this.

This early stage of gall-tract disease is the one we must learn to recognize if we are to take the first practical step in the prevention of the later more serious states of catarrh and infection, pathological inflammatory thickenings, adhesions, and gall-stone formation which inevitably follow by more or less rapid transitions, each of which so altering or increasing the symptoms that ultimately we reach the historically perfect picture of gall-tract disease which none of us can mistake. Gall-tract disease recognized in its early beginnings will be found readily amenable to a few weeks' course of medical drainages and the use, if need be, of autogenous vaccines. Of course, such early gall-tract disease can and does concomitantly exist with catarrhs and infections of the stomach, duodenum, large and small bowel, appendix and the recto-sigmoid, all of which can be recognized in most cases as making up part of the total picture of certain types of early gastro-intestinal indigestion, and each should have its appropriate share of treatment. (See Report of Case IV.)

I believe that if more of these cases at this early stage were treated by medical drainage of the gall-tract coupled with Jutte's method of transduodenal lavage, Norman's method of colonic drainage, Soper's methods of sigmoidoscopically treating the recto-sigmoid, and perhaps Bassler's or Satterlee's method of colonic implants of antagonistic bacteria and entero-antigens, that we could discard many of our utterly unscientific prescriptions of diets and the interminable list of gastro-intestinal drugs, and restore our patients to a degree of health that would increase their life expectancy and prevent unnecessary surgery.

Among the group of gastro-intestinal organs, the appendix alone is the one important member which is fraught with danger in suddenly jeopardizing the life of the young or middle aged adult and should be carefully watched for the first clean-cut evidence of its disease and then be surgically removed. At this stage the mortality is practically *nil*. Nevertheless, many an innocent and properly functioning appendix has been needlessly sacrificed on the altar of faulty diagnosis. I believe that we have crossed the threshold of a more conservative era in abdominal surgery because we have learned by our mistakes. The day has certainly passed when surgical enthusiasm would still condone the fixation of floating kidneys in well developed Glenard's disease; the wholesale removal

of ovaries and Fallopian tubes; total resections of the colon except when guided by a scientific discrimination as displayed by Cotton and his associates; and the routine employment of the unscientific, because unphysiological, gastroenterostomy for the cure of peptic ulcer *unless* it be complicated by definite pyloric obstruction, or *unless* it be done to prolong life in inoperable gastric cancer involving the pylorus. So, too, I believe that we will learn a greater conservatism in the surgical management of gall-tract disease, just as we have learned a lesson of conservatism in regard to the wholesale extraction of teeth and tonsils unless justified by the soundest kind of evidence.

Among this group of early gall-tract disease which has been shown to respond most favorably to medical drainage are to be found another large group of individuals, whom I described in an earlier chapter, who have periodic or cyclic attacks of so-called "biliousness" or "lazy" or "torpid" livers, ushered in by gradual loss of ambition, increasing sense of mental or physical heaviness or lethargy, constipation, furring of tongue, metallic sense of taste, loss of appetite, and headaches and eyeaches of greater or less severity; many attacks terminating in the true migraine type accompanied by nausea and vomiting, various ocular manifestations, dizziness and various degrees of prostration, a group of symptoms that in some degree we meet within our practice nearly every day. Such patients find that they gain their best temporary relief by the use of cholagogic laxatives, which, however, do not cure them, and inevitably sooner or later they drift into the later stages of gall-tract pathology which will ultimately require surgery. Many such patients will make a prompt symptomatic response to medical drainage of the gall-tract, although it must be kept up sometimes for long periods until all of the pathological objective findings and toxic factors have disappeared from the bile. (See Report of Cases III, V, and VI.)

Certain very severe types of true biliary migraine have been apparently cured by this method where all other measures of treatment have failed. On the contrary, a few comparatively mild and apparently early cases of cholangitis and cholecystitis have proven too stubborn for permanently successful medical drainage and have too frequently shown a tendency to relapse so as to ultimately require surgical removal of the gall-bladder, to be followed by further medical drainage to protect the ducts. I am glad to say that this type has only been occasionally encountered, and that therefore medical drainage intermittently practised over a period of at least six months should be urged as a trial in all cases of this type before surgery is to be seriously considered.

Many of the patients in this group were formerly of the type who agreed to undergo an exploratory laparotomy—a form of operative

procedure fortunately now being frowned upon—and in whom the surgeon usually failed to demonstrate any pathology in the upper right quadrant because it is in too early a stage to give visual or tactile evidence of its presence. The beneficial net result of such an operation was usually *nil*, and indeed in certain patients left them with a surgically traumatized peritoneum and a damaged abdominal wall.

Group E.—Genuinely Surgical Cases to Be Preceded by Preliminary Medical Drainage.—I feel that in this group should be included those cases of gall-stones, cystic duct obstructions, with no surgical contraindications, as defined above, and those cases who give evidence of inflammatory adhesions involving the upper right quadrant as a result of a local or low grade peritonitis, but in whom, by our diagnostic drainage, we have demonstrated the presence of a duct catarrh and infection. My reason for this belief is because I have learned that this is the type of case that if surgically cholecystectomized or cholecystostomized without a preoperative knowledge that a choledochitis or cholangitis also exists (and is appropriately treated surgically), is very apt to surgically relapse as a result of the residual duct infection, and later to develop a very clinically evident picture of cholangitis with intermittent exacerbations of acute pain accompanied by jaundice or a chronic state of upper right quadrant distress with varying degrees of icterus. Even if this state of duct catarrh and infection is preoperatively recognized it appears to me doubtful as to whether it can successfully be “appropriately treated surgically,” for I have had a too long series of such cases postoperatively referred after having gone through a cholecystectomy combined with a choledochostomy and in whom the direct evidence of cholangitis still persists. (See Report of Cases I, XV, XVI, and XVII.)

I believe that we would accomplish more for the permanent cure of this group of patients if we preceded their necessary surgery by a period of medical drainage of the gall-tract practised intermittently over a period of several weeks, or in the more urgent cases by a week to two weeks of continuous medical drainage, and thus decrease or limit the infection and better prepare the surgical field. It is astonishing to see how much inflammatory and catarrhal and infected material can be recovered in the biles and can be removed from the body, thereby lessening the toxic dose which would otherwise be absorbed. And it is likewise astonishing in many cases to see the clinically favorable response to this measure of direct treatment, often to such a degree as to make it appear questionable on the part of the patient as to whether there is sufficient justification for submitting to operative interference. However, where true surgical pathology is known to exist this step should by all means be taken, *but* three to six weeks later medical

drainage of the gall-tract should be again resumed and continued until the objective findings of residual infection, as demonstrated microscopically and culturally, cease to exist. By sensibly combining these medical and surgical measures I believe we can materially improve the permanency of success in the management of this group of patients and can prevent unnecessary surgical relapses. This has become evident to me since I have adopted this plan of procedure in my personal cases. (See Report of Case X.)

A second important group of surgical cases which should be preceded by medical drainage are those patients who have an obstructive jaundice due either to extensive cholangitis or to impacted ball-valve stone in the common duct. No surgeon of experience will willingly operate during such a period of jaundice on account of the increased danger of hemorrhage and the increased period of postsurgical and postanesthetic shock. The soundness of this principle is generally recognized by the surgical divisions of our better hospitals, and as a preliminary measure of treatment such patients are kept in bed, on a diet of hot liquids, with the use of various chologogic medicines and either hot or cold applications to the upper abdomen. Under such procedures the icterus may be gradually reduced, although in many cases it persists over a period of several weeks.

I have learned that medical drainage of the duodeno-biliary tract is an eminently practical presurgical procedure for many such patients, and will often bring a surprisingly prompt decrease in the jaundice and a lessening of the general evidence of toxemia, so that the patient may be more promptly and more safely operated upon with materially lessened postoperative shock.

For instance, this method was practised on a toxic, deeply jaundiced patient with an impacted ball-valve stone in his common duct. After the stone impaction was released as a result of the continuous irrigation of the duodenum with hot solutions, we succeeded in recovering in twenty-six hours drainage four and a half *liters* of a dark, mixed or unsegregated bile which contained very viscid, stringy and lumpy plugs of mucopus and microscopical inflammatory débris, and secured a marked decrease of his jaundice, a lessening of his toxemia, and an easement in his pain in twenty-four hours. By this means we withdraw from the body large quantities of poisoned bile (just as is surgically done by a cholecystostomy) and lessen the toxic dose that is being carried by the blood to the heart muscles, kidney and liver cells, and, furthermore, protect the intestinal tract against transplanted infection. This unquestionably should be a help to the surgeons in still further reducing their operative mortality. (See Report of Case XIV.)

Group F.—Genuinely Surgical Cases to be Followed by Medical Drainage.—This group to a certain extent overlaps Group E, in which I have tried to show that those cases who preoperatively give evidence of duct catarrh and infection should resume the medical drainage of the gall-tract three to six weeks after the necessary surgery has been done, in order to diagnostically determine whether there is still evidence of residual infection, and if so, that medical drainage may be instituted routinely at intervals of every two or three days and continued so long as the objective findings remain positive. We will do much more, I believe, to prevent the likelihood of postoperative relapse if we disregard the sometimes misleading criterion that an arrest of symptoms, which so frequently immediately follows surgical interference, means a real cure, and instead pin our faith on a disappearance of objective findings (pus cells, inflammatory débris, strands of mucus, and culturally recoverable pathogenic bacteria), which is certainly a much more scientific criterion of actual cure. (See Report of Case X.)

If in a given case this early postoperative diagnostic check-up should not appear advisable, certainly no case falling in this group should fail to have such a postoperative study within three months after operation, and if catarrh or infection be still demonstrable, duodeno-biliary drainages should be instituted and continued until normal findings are secured. Indeed, prophylactic drainage might well be given once each month to forestall a relapse, even in a surgical case apparently cured.

In this connection, too, it has been extremely interesting to again postoperatively study certain gall-stone cases, in some of which a cholecystectomy had been performed, and in others a cholecystostomy. In most of these cases the operative procedure of either removal of both stones and gall-bladder, with a common duct drainage, or the removal of the stones with gall-bladder drainage resulted in an apparent symptomatic cure, but in postoperatively comparing the findings with those preoperatively secured, it was found that two or three months after the operation we could still recover the same infecting organism that existed prior to operation, and that the bile showed the same inability to hold its crystalline chemistry in solution and still contained increased mucus and inflammatory débris. (See Report of Case IX.)

This, scientifically, is far from a cure of the condition, and certainly tends to postsurgical relapses, since all of the factors that are theoretically necessary for the production of stones are still present, and there is no assurance that they will not re-form. Indeed, it is quite likely that they will re-form, especially in cases in which the common duct and hepatic ducts dilate and, through improper

drainage, contain static bile, or in those cases who develop a post-operative cholangitis with mechanical obstruction leading up to stagnation of bile within the ducts and liver. Cases of this sort have certainly come within the observation of every upper abdominal surgeon of average experience, and the unpublished records of such cases can frequently be read by any doctor who has access to any large series of operatively managed gall-tract cases.

As my personal experiences and opportunities for after observation have increased, it has appeared to me most likely that, aside from the two possibilities of the etiology of stone re-formation recited above, perhaps we may look for another etiological factor in liver cells so seriously damaged as a result of long continued hepatic toxemia, or so degenerated from increased intrahepatic pressure resulting from long continued jaundice, as to be functionally unable to secrete a bile which is capable of holding its crystals in solution or a bile which may be deficient in certain other elements of its physiological chemistry. Having this sort of evidence repeatedly recurring in many gall-stone cases making up this group, it has seemed to me a most practical way of meeting this situation, and thus preventing, as far as possible, such calculus re-formation, by adopting medical drainage of the gall-tract and continuing it for long periods, if necessary, until the objective findings materially lessen or disappear.

By putting such a plan into practice I have found it possible to clear up the remaining evidence of disturbed physiological chemistry and positive bacteriology in a number of cases. The underlying principle of this success seems to rest in the fact that by medical drainage of the gall-tract we have our most effective method of *draining the liver itself*, and also by this very means of flushing out the ducts, and by so removing from the body certain quantities of bile, poisoned metabolically and bacteriologically, perhaps in direct proportion, reduce the toxic dose which will otherwise be partly reabsorbed into the portal circulation and carried back again into the liver, to again poison the already tired liver cells. Relieved each day of a certain amount of this toxic load, it is conceivable that a certain proportion of liver cells which have not been permanently damaged may recover varying degrees of their former functional capacity and be better able to elaborate a bile more normal in its excretory, secretory and absorptive properties. This may so improve the states of impaired metabolism involving other organs of the gastro-intestinal tract, and indeed other less intimately related systems of the body, as to be partly responsible for the very marked general improvement in the total picture of the patient that I have seen to result from such a method of treatment.

You will see from what I have already said in my discussion of

these various medical and surgical groups of patients that we may best accomplish our efforts of arresting the progress of gall-tract disease and of better preventing gall-stone formation if we make use of the early diagnosis of such conditions which is afforded by the diagnostic possibilities of medical drainage of the gall-tract, and when so recognized to promptly institute medical drainage as a therapeutically successful measure; that where a given patient has reached a stage of advanced gall tract pathology (gall stones, inflammatory adhesions, localized peritonitis), we may have a better chance of getting such a patient permanently out of his difficulties if we sensibly combine with the necessary surgical procedures a preliminary and follow-up period of medical drainage of the gall-tract.

Before leaving this discussion I would like to refer again to the wisdom of surgically leaving in the gall-bladder *when possible*, rather than routinely removing it, in all such cases in whom preliminary diagnostic medical drainage has shown that the gall-bladder so studied retains a reasonable degree of function, even though it may contain stones or is proved to contain infected bile. All cases of mechanical cystic duct block are automatically excluded from this group, and there are in addition certain other exceptions in which the gall-bladder unquestionably should be removed. These exceptions, I believe, should be limited to the removal of such gall-bladders as at operation are found to have such firm adhesions, the releasing of which alone does not indicate the likelihood of restoration of proper function of the gall-bladder; namely, the markedly atrophied or fibrous gall-bladder so often found contracted around a solitary stone or the dilated, atonic gall-bladders with paper-thin walls and a destroyed musculature; the gall-bladders showing mucosal pathology of the true "strawberry" variety; the cancerous gall-bladder and such gall-bladders as show evidence of a beginning but definite necrosis or impending gangrene. All such gall-bladders should very properly and wisely be removed.

But, too often, gall-bladders which do not fall within any of the above classifications have been routinely resected on the grounds that the gall-bladder from a surgical point of view does not possess any necessary function, since certain patients have been known to get along quite well without them. For this group of gall-bladder cases I believe we would do more wisely to practice conservative surgery *combined* with postoperative medical drainage. (See Report of Case II.)

In other words, it now seems possible that we may be able to return to the so-called "ideal gall-bladder operation," advocated by McRedit in 1883, only to be later condemned most heartily by Moynihan and other surgical authorities, because it was learned

that such insufficient surgical procedure too frequently failed to eradicate the surgical pathology. This ideal operation consisted in removing gall stones and inspissated mucus and gall-sand from the gall-bladder, curetting or sponging off its mucosa and closing up the gall-bladder without drainage. Today we might entertain the hope of returning to such a method of procedure with better success if we immediately follow up such operative procedures with medical drainage of the gall-tract.

As stated above, such a method of choice must be limited to those cases in whom a preoperative medical drainage has shown it possible to drain the gall-bladder, partially or wholly, of its fluid contents, and that it appears to still possess a reasonable degree of function. Certainly it would seem wise to discontinue surgically draining infected gall-ducts through a functionally sound and perhaps non-infected gall-bladder, for it is now a surgical axiom that the best way to infect a non-infected tract is to drain it. Such cases I believe can be much more appropriately reached and effectively drained through non-surgical duodeno-biliary drainage.

Group G.—Essentially Medical Cases.—

1. Catarrhal jaundice.
2. Arthritis.
3. Typhoid carriers.

In some respects this group overlaps certain cases which were discussed in Groups C and D, namely, certain border-line and early cases which were formerly only amenable, or partially so, to surgical procedures, but which now, I believe, might much more successfully be managed by medical drainage alone. In addition to the cases within those groups we have several other types which should be considered essentially medical and for whom surgery as a rule is not indicated.

The first and perhaps most important group are cases of *catarrhal jaundice*. This condition, which heretofore has been very lightly considered, is usually the result of the extension of a gastro-duodenal catarrh, which, apparently by direct continuity, spreads into the common duct and extends upward to varying distances. In almost every instance when this condition reaches a point of clinical recognition through staining of the sclera, hard palate and skin it has reached a point where it has caused a complete obstruction of the common duct. It has generally been looked upon as a disease of little importance because it is usually self-limited, does not as a rule produce serious symptoms, and rarely of itself has ever proved fatal. The duration of the average case of catarrhal jaundice is between three and a half and six weeks. To me this apparently simple disease has for some years taken on a more serious significance, not so much as regards its immediate effects as the

importance of its sequelæ as represented by its potential damage to liver cells and function, as well as to the tissue and function of the pancreas.

This has been brought out more forcibly by the experimental work of Rous and McMasters, who have demonstrated that in order to produce tissue and skin icterus on dogs and monkeys they have to mechanically obstruct from 75 to 95 per cent of all of the hepatic excretory channels. This animal experiment, they believe, may be representative also of the state of obstructive jaundice in human beings. Therefore, for every day that such obstructive jaundice persists the liver and pancreatic cells are subjected to the pressure effects of the damming back of the continuous external secretions elaborated by each of these organs, so that their cellular functions are impaired and certain structural damages may ensue which may later result in biliary or pancreatic cirrhosis.

Indeed it now seems likely that certain cases of diabetes may directly owe their origin to a preceding attack of catarrhal jaundice which had occurred some years before. (See Report of Case XLIV.)

Having this in mind, and in the attempt to shorten the duration of jaundice, it seemed possible that by adding medical drainage of the gall-tract to the usual symptomatic management of catarrhal jaundice that something further might be accomplished. I have found that it is possible by adding this practical and direct measure of treatment to cut the duration of the average case of jaundice a little more than a half. Indeed, in certain more favorable cases it has been possible to open the common duct and to establish drainage and to clear all visible evidence of jaundice in as short a time as seventy-two hours. The promptness with which this can be accomplished depends somewhat upon the extent to which the obstructive catarrh has ascended the common duct, but in a few instances it has been possible to dislodge the larger amount of the obstructing plug of mucus within a few hours' time and to establish partial drainage, which thereafter becomes more and more rapid as the dammed up bile in the liver aids in flushing out the ducts. The procedure by which this is accomplished is to intubate the duodenum to the proper point and to continuously irrigate it with hot solutions introduced by the drip method and the intermittent use of magnesium sulphate to encourage the duct sphincter to relax and the gall-bladder to contract, and by so doing mechanically help to force out the obstructing plug of mucus.* In certain cases it will be found that after the common duct has been freed of most of its obstructive catarrhal swelling that the cystic duct still remains blocked for some days thereafter. (See Report of Case XXVI.)

Secondly, there are certain forms of *arthritis* in which the addition of medical drainage of the gall-tract has proven of great service.

* See Figs. 117 and 118.

I am referring to certain types of progressive chronic arthritis, in which all the suspected primary foci of infection in tonsils, teeth, sinuses, prostate, seminal vesicles and female pelvic organs have been recognized, removed or appropriately treated without appreciably arresting the progress of the disease. In several such cases a definite secondary focus of infection has been found in the gall-bladder or in the entero-colon and the patients have made prompt response to medical drainage of the gall-tract, combined with transduodenal lavage, colonic irrigations, the direct treatment of the recto-sigmoidal apparatus, and the use of autogenous vaccines.

Where there is a demonstrable infection in the gall-bladder and ducts the same principles apply in the selection of cases for medical and surgical management as were discussed in Groups A and B, but even if a badly infected and pathologically damaged gall-bladder in such a case may have to be surgically removed as a preliminary stage in the treatment, it has been found that by postoperatively resuming medical drainage the arthritis tends to become better arrested and the patient makes a more progressive improvement.

The reason for this appears to lie in the suggestion that such cases continue to be metabolically and perhaps bacteriologically poisoned through hepatic and intestinal toxemias. For instance, if there is an intestinal focus of infection, as well as a gall-bladder focus, both of these organs pass a certain part and a certain amount of their toxins into the portal vein, whence they are carried to the liver. This in turn gradually so poisons the liver cells that one or all of their three-fold functions are gradually impaired so that, due to failure of proper excretion, certain of the toxins are retained within the liver and increase the cellular damage. That part which is still capable of excretion by way of the bile in its passage through the intestine is again reabsorbed in part into the portal blood supply and this vicious circle is continued until the patient is overwhelmed by the increasing toxemia.

It was conceivable that if a certain amount of this poisoned bile could be removed from the body before passing through the intestines, the toxic dose to the liver and later to the intestines could be gradually reduced with the hope that a better cellular function might eventually be established. In a limited series of cases this possibility seems hopefully possible of fulfilment if cases of this type can be recognized reasonably early and can be given an intensive course of continuous biliary drainage for a period of three or four weeks, with intermittent drainage thereafter. (See Report of Case XLII.) It is truly amazing to see the enormous amounts of pathological bile that is capable of withdrawal from the body in a comparatively few days with marked clinical improvement and no apparent ill effect. One case of postoperative cholangitis with

apparently a chronic hepatic toxemia drained $34\frac{1}{2}$ ounces or over 10 liters of recovered bile in five days of continuous drainage, with a decrease in the patient's weight of only $\frac{1}{4}$ pound.

In another patient with chronic osteoarthritis, in fourteen days of continuous drainage we recovered 665 ounces or 5 gallons of bile. In both of these cases we apparently recovered practically all of the secreted bile inasmuch as the stools become clay colored and acholic.

In a *normal* individual this removal of bile over consecutive days might well be prejudicial to health and would certainly interfere with normal digestion, but in pathological cases such as these, in which the bile itself is definitely poisoned bacterially and chemically, and producing a toxemia affecting other organs, its removal from the body before it has an opportunity to pass down through the intestinal tract, with resorption of its toxins, is probably beneficial, as witness the marked improvement of the damaged myocardium and kidneys.

Of course, it is not to be inferred that the damaged joint structures can be repaired, but it has certainly seemed possible to improve their function (in the sense of increasing their mobility) and ease their pain, and certainly to check the usual insidious process of the disease. (See Report of Case XLII.)

Lastly, as essentially medical cases we can consider *typhoid "carriers,"* when recognized early, as being amenable to medical drainage of the gall-tract. I say this because during the summer of 1920 we had a mild epidemic of typhoid fever and it was found that several of these fully convalescent typhoid patients were delayed in their hospital discharge because their cultures from the stool (and occasionally from the urine) were repeatedly reported from the laboratory as positive for typhoid bacilli. Practically all of these patients were found to be harboring typhoid bacilli in their gall-tract and the larger number of colony counts were obtained from the static gall-bladder bile. By applying medical drainage over a period of several days to several weeks it was found that this residual typhoidal focus could be culturally eliminated and such patients could then be discharged without becoming a future menace to the community by still possessing an unrecognized "carrier" focus.

This is the time, as I have stated in an earlier chapter, to recognize and treat such a case by non-surgical drainage, and perhaps prevent gall-stone formation, so commonly a sequela of typhoid fever, and again I would suggest the advisability of culturally testing by medical drainage the biliary excretions of all convalescent typhoid patients, both to prevent their becoming "carriers" and to guard them from later developing more serious gall-bladder disease. Indeed, it would be most interesting if the known typhoid "carriers" who are now incarcerated or under continued observation in various

State institutions could be tested out for a residual focus in the gall-tract, as distinct from such patients who may harbor the infection in the kidneys or urinary tract. Perhaps certain of these long-standing cases might be cleared up by medical drainage, and those which fail of such recovery might be cured by a cholecystectomy with postoperative medical drainage of the liver and ducts.

There are certain other diseases which in the future may fall into this group of essentially medical cases which can be improved by medical drainage of the gall-tract, but about which we as yet know too little to express an opinion. I refer to certain cases of pernicious anemia, of grave secondary anemia, and to certain diseases of the spleen and pancreas. (See Report of Cases XLIII, XLIV and XLV.)

CHAPTER XXIV.

TREATMENT.—(CONTINUED.)

SELECTION OF CASES FOR INTERMITTENT AND CONTINUOUS MEDICAL DRAINAGE OF THE GALL-TRACT, WITH DISCUSSION OF METHOD.

Now let me discuss the selection of cases for whom intermittent non-surgical drainage is indicated and those who will respond better to continuous non-surgical drainage.

The only difference between the general principles of the two methods lies in the fact that in *intermittent* drainage the duodenal tube is left *in situ* for only a short period, from two to six hours, during which time two or three magnesium sulphate stimulations are given, and as much bile recovered and removed from the body as possible, and the treatment then terminated by duodenal disinfection and a transduodenal enema; whereas in *continuous* drainage the tube is allowed to remain in the duodenum day and night for a period of several days up to three weeks with, as a rule, two magnesium sulphate stimulations a day to secure evacuation of gall-bladder bile, and the recovery of this and as much liver bile as can be secured between the feeding periods during the day and by continuous drainage during the night.

INTERMITTENT MEDICAL THERAPEUTIC GALL-TRACT DRAINAGE.

Medical drainage of the gall-tract in all groups (except A), as described in the preceding chapter, can be practised at stated intermittent periods, daily, every other day, twice or once a week, or once every fourteen, twenty-one or thirty days according to the conditions existing in the individual patient. There are certain exceptions to this in the selection of cases for whom continuous medical gall-tract drainage will accomplish better and quicker results than will intermittent drainage. (See page 467.)

The general steps in a diagnostic medical gall-tract drainage have been discussed in abbreviated form in Chapter XVII and at greater length in Chapter XVIII. In general the technical steps necessary in a therapeutic drainage are no different from those in a diagnostic drainage except that less care in the attempted sterilization of the

mouth, esophagus and stomach is required, and indeed if the oro-nasal cavities are free of focal infections this step can be disregarded; and less time need be expended in the thorough cleansing of the stomach, preliminary to intubating the duodenum, except in those cases who have a coexistent gastric catarrh, infection or neuro-muscular defect. At least half an hour can be saved if the stomach does not require this preliminary treatment.

Having intubated the duodenum successfully, one, two or three stimulations with 33 volumetric per cent solution of magnesium sulphate are given and the maximum amount of this solution recovered promptly. The amount of the first stimulation is 75 cc, of the second 45 cc and of the third 30 cc and we take care not to exceed 90 cc of the solution retained by the patient. This is equivalent to 1 ounce of the full saturated solution and represents a full dose for the sthenic patient which can be tolerated, as a rule, without depressing effect or unusually severe laxation. Proper consideration should be given to the laxative response of the individual patient. It is desirable to secure 1 to 3 fluid evacuations within the first two to four hours after draining an infected gall-tract to avoid transplanting the infection to the intestines. Certain laxative-addicted, constipated cases will not secure free fluid evacuation following this full dose of magnesium sulphate, and their duodenal enemas of Ringer's solution can be reinforced by the addition of $\frac{1}{4}$ to 1 teaspoonful of sodium sulphate, sodium or magnesium citrate, or one tablespoonful of milk of magnesia.

There seems to be another useful factor in the use of sodium sulphate after a drainage besides the securing of a laxative effect. This is due to the constricting effect that the sodium salt has on unstriated muscle which will overcome the too relaxing action of magnesium sulphate and will tend to reestablish the normal tonicity of the gut. This is especially useful in those cases who have an already existent *intestinal atony* which is increased by the magnesium salt and who, therefore, tend to become uncomfortably distended with gas after a biliary drainage. Indeed in certain more advanced atonic cases I have seen their abdomens become highly tympanitic, with such a complete absence of intestinal peristalsis as to require an injection of pituitrin or of eserine sulphate, until I learned that this could be overcome by sodium sulphate, as suggested by Meltzer. Certain cases, on the contrary, who have a tendency to a *spastic* enterocolon should not be given sodium sulphate as a reinforcing laxative, but instead magnesium citrate or milk of magnesia would serve better. The usual dosage I prefer is 2 drams of the crystals of the former or 15 to 30 cc of the latter. In certain cases olive oil may be substituted for magnesium sulphate as described on page 319. It may be used to advantage

in cases who have diarrhea to avoid over-laxation, or in cases who have unusual postdrainage pain or discomfort. On the other hand, certain patients will be found who do not tolerate olive oil and for these its use should not be encouraged. Often a patient in this group will be found to have a deficiency in pancreatic steapsin and of some element in the bile, and is unable to split and absorb the 5 to 15 cc of olive oil retained.

An intermittent drainage intended primarily to drain the *gall-bladder* can usual be terminated in from one and a half to two hours after drainage has been established. If, in addition to draining the gall-bladder, drainage of the *liver* is indicated, the drainage period should be prolonged for several hours, (four to six or more), and for this purpose additional stimulations can be given with 50 cc of a 10 per cent peptone solution or 50 cc of a 0.5 per cent solution of hydrochloric acid. These may be given in addition to one or two stimulations with magnesium sulphate solutions (33 volumetric per cent).

Intermittent gall-tract drainage is indicated in the following groups:

1. Early or subacute cholecystitis or choledochitis with or without infection.

2. Acute cholecystodochitis with or without infection.

3. Acute exacerbation of a chronic cholecystodochitis with or without infection.

4. *Quiescent* cholelithiasis with duct catarrh or infection or superimposed hepatic or intestinal toxemia.

5. *Restive* cholelithiasis, but with pronounced *surgical contraindications* and superimposed hepatic or intestinal or systemic toxemia. Drainage by magnesium sulphate here should be practised cautiously to avoid encouraging stone passage. Hepatic drainage secured by peptone or hydrochloric acid solutions or with salt solution, or even hot water should be tried if there is much postdrainage pain following magnesium sulphate.

6. Preoperative or postoperative cholangitis of low grade. Certain cases will do better by continuous drainage.

7. Postoperative persistent fistula with residual infection in gall-bladder or ducts.

8. Empyema of gall-bladder with pronounced *surgical contraindications*. Great caution should be observed by reducing the amount and multiple use of magnesium sulphate stimulations. If the microscopical picture of excessive necrosis suggests possible gangrene the treatment should be interrupted and resumed in a day or two if conditions permit.

9. Acute cholecystitis, complicating typhoid fever or other acute infections, or pelvic sepsis in cases in which the surgical risk

is considered too great or when occurring in cases of Graves' disease, severe myocarditis, Bright's disease, or in the very aged or the very asthenic or severely visceroptotic patient.

10. Cystic duct mechanical block due to intraduct catarrhal swelling, as suggested by microscopical picture of dense mucus, often spiralled, oleaginous globules, pools or lakes, amorphous bile salts and inflammatory débris.

11. Gall-bladder atony with or without apparent cystic duct obstruction due to physiological block.

12. Biliary cirrhosis, with or without chronic pancreatitis.

13. Chronic biliousness of various grades.

14. The biliary form of migraine. In certain cases continuous drainage for a week followed by intermittent drainage will prove more effective.

15. Hepatic toxemia of various grades, with mental depression ranging into the milder forms of melancholia. In certain cases continuous drainage, if tolerated, will bring about earlier improvement.

16. Pernicious anemia and chlorosis. My experience here has been confined only to intermittent drainage. Doubtless certain cases might tolerate continuous drainage equally well or better.

17. Hemolytic jaundice with splenomegaly. The one case I have had might have done even better if he had consented to continuous drainage. Smithies refers to Banti's disease as being helped by biliary tract drainage. I have had no personal experience with such a case.

18. Hepatitis due to various poisons—lead, phosphorus, arsenic or ptomaine, with associated toxemia.

19. Cholecystitis, associated with duodenal or pyloric ulcer when treated by gastric "splinting" and duodenal feeding.

THE TECHNIC ADVISED FOR CONTINUOUS MEDICAL GALL-TRACT DRAINAGE.

The patient undergoing this treatment should preferably be placed in a hospital having a proper diet kitchen and a good working laboratory. It is possible to carry this treatment out successfully at home, although under greater nursing difficulties and with less opportunity to check up on the progress of the patient by frequent laboratory examinations. The patient must have a special nursing attendant who preferably should be a trained nurse. This, however, is not essential, but it is most important that the person assuming the direct technical management of the case should be familiar with duodenal tube work and the general funda-

mental principles of medical drainage of the gall-tract. I have found it of advantage to train a reasonable number of nurses for a few weeks in my private and out-patient clinics until they have become sufficiently well grounded in the method to take over the active care of a patient in a hospital or at home. The average trained nurse can acquire a sufficient familiarity with all steps in the procedure in one or two weeks of such training, depending upon her general adaptability to this work.

It is good policy to discuss with the patient the general plan and the purposes of the treatment which is to be undertaken, to fully acquaint him with the usual time limits of from one to three weeks during which he must continue to retain the duodenal tube, and to secure, so far as possible, a hearty coöperation from him. This established an *entente cordiale* between the patient, the doctor and the nurse. It is possible to honestly assure the patient that the treatment will not be as difficult or trying as he anticipates. It is surprising to see how promptly the patients become accustomed to the presence of the duodenal tube.

In practically all cases selected for this plan of management it is an entirely painless procedure. In the occasional patient, however, with definite surgical contraindications, but possessing restive gall stones with or without hepatic or intestinal toxemia, there may be some exacerbation of pain attacks (much the same character as those in the presenting complaint) which follow the magnesium sulphate stimulations, which tend to cause contractile muscular effort on the part of the gall-bladder. If this occurs care should be exercised in diminishing the frequency and dosage of the magnesium sulphate stimulations to once every third or fourth day with a single injection of 50 to 75 cc of a 33 per cent volumetric solution. Stimulations with peptone (50 cc of a 10 per cent solution) or with hydrochloric acid (50 cc of a 0.5 per cent solution) will do quite as well as a hepatic secretagogue and aid in flushing the ducts and draining the liver without so much influencing gall-bladder contraction. After all, in the treatment of this type of case the hepatic flushing and the duodenal enemas will reduce the hepatic and intestinal toxemia, and in many cases so improve the general clinical picture of the patient that the surgical contraindications disappear and the necessary surgery can be practised with a reduced mortality risk.

Before instituting this method of treatment it is a good plan to make sure that the patient's throat is free of pharyngitis or other local irritation. If not, a few days' treatment for this will subsequently make matters much more comfortable for the patient. The gums also may require some preliminary attention.

As a matter of routine the following orders are typewritten and given to the nurse or technical assistant in charge of the case. These instructions will cover the average case, and can be modified to meet individual requirements. Certain of the orders can be changed by underlining or striking out the proper "may" or "may not."

Nursing Directions for Miss (name of nurse) in the Case of Mr. (name of patient).

I. On the afternoon preceding the beginning of treatment give the patient a simple cleansing enema.

II. On morning (date) the patient is to have no breakfast. Wash the stomach in the usual way. Get tube into duodenum and do a gall-tract drainage with magnesium sulphate in the usual manner.*

For as long periods as possible, when food is *not* appearing in glass window of tube and being drained out, keep tube unclamped and attached to drainage bottle for recovery of the maximum amount of bile which can be secured. At night, two hours after the last feeding, unclamp tube and continue drainage throughout the night.

Measure and describe all quantities of bile secured and keep a separate record of day and night drainage with a total twenty-four hour summary. When requested keep a special record on the Biliary Tract Drainage Sheet.

III. Each morning give a duodenal enema of 250 cc (or 500 cc) of Ringer's solution (or Jutte's solution, if so ordered). One-half teaspoonful of the crystals of sodium sulphate (or 1 tablespoonful of milk of magnesia, if so ordered) is to be added only if the bowels require additional laxation. Introduce this by the Murphy drip method at 105° F. taking at least twenty minutes for each 250 cc of fluid introduced.

Each morning (or second, third or fourth morning, if so ordered) precede the duodenal enema with a magnesium sulphate gall-bladder drainage (1 stimulation of 75 cc of 33 per cent volumetric solution).

IV. If so ordered follow the gall-bladder drainage with a duodenal disinfection with 100 cc of silvol (or potassium permanganate) solution, 105° F. (using 10 cc of the 1 to 500 *fresh* silvol solution or 1 to 500 potassium permanganate solution added to 90 cc of sterile distilled water), removing by syphonage as much as you can, and then follow with the duodenal enema as above.

* The nurse is, of course, familiar with the technic. The reader may refer to Chapters XVII and XVIII.)

V. If *specifically ordered*, irrigate duodenum twice a day with
A. 100 cc of *fresh* silvol solution, 1 to 5000, and recover as much as you can.

B. 100 cc of potassium permanganate solution, 1 to 5000, and recover as much as you can.

Or instill into duodenum:

A. Hexamethylenamine gr. v (gm. 0.3) in 30 cc of water once, twice or thrice daily (as ordered).

B. Sodium salicylate gr. x (gms. 0.6) in 50 cc of water once, twice or thrice daily (as ordered).

C. Mercurochrome gr. viiss (gm. 0.5) in 50 cc of water daily or e. o. d. (as ordered).

D. Neoarsphenamine (dose to be determined and prepared only by doctor) in 50 cc of water every second, third, fourth, or fifth day (as ordered).

E. Culture of *B. acidophilus* (dosage to be ordered by doctor).

F. (Any additional medication by duodenum as ordered and written by doctor).*

VI. *Dietetically*: Liquid feedings by mouth of all kinds of broth and thin strained vegetable or cereal gruels, with 2 oz. of beef juice each day. Milk or half milk and cream, or boiled rice, medium cream and sugar. (Where milk foods are used, powdered caroid gr. 3 [gm. 0.2] or ess. caroid 3 ij [8 cc] are to be added to each feeding).

Egg albumen or orange albumin, or 1 to 3 coddled eggs daily. Zwieback, dry or buttered, and well chewed.

Liquid feedings to be 6 oz. every two hours from 7 A.M. to 7 P.M.

When specifically ordered duodenal feedings of the following formula are to be substituted for or added to the mouth feedings:

Milk (whole)	120 cc (4 oz.)
Cream	15 cc ($\frac{1}{2}$ oz.)
Yolk	1 egg
Lactose	15 gm. (4 tsp.)
Salt	1 pinch

Predigest for ten minutes with peptonizing powder, put in thermos bottle at 105°F. and introduce slowly by Murphy drip method taking not less than twenty minutes for its introduction.

* Neutral acriflavine has been used in the duodenum for its antiseptic action in 50 cc amounts of 1 to 2000 solution without untoward reaction. The results of the use of this drug are still somewhat undetermined.

VII. *Medicinally*: Pil pancrobilin plain, t. i. d. and (or) senna agar fruit paste,* 1 olive-sized piece, if necessary to further encourage bowel function.

VIII. *Vaccine Injections*:

Give autogenous vaccine of.....(name of bacterium) according to following directions:

Injections are to be given subcutaneously into the arm about two inches above the external condyle every fifth day, using the usual aseptic precautions. The first injection is to be 1 minim and the dose is to be doubled at each injection until 8 minims have been given, when the dose is to be increased thereafter by 50 per cent until 1.5 cc has been reached, and this dose continued four or five times. If there is any reaction beyond a mild local one following any injection the dose is not to be increased thereafter until the dose causing the reaction has been repeated and has not again caused it. The vaccine bottle is to be shaken thoroughly before it is used, and the vaccine should be kept in the ice-box. The rubber top is *not* to be taken off, but is to be sterilized with alcohol or a drop of lysol, and the needle plunged through the rubber with the bottle inverted.†

IX. Weigh and record weight of patient on admission and once a week and on discharge. *Stand patient with back to scales.*

X. A. The patient must be kept in bed except for essential toilets.

B. The patient need not be kept in bed, may go to sun parlor, open air bridge or to grounds (in wheel chair). When patient is out of bed during periods of bile drainage the drainage bottle can be carried in pocket of dressing gown or pinned to gown by attached tape.

XI. Laboratory examinations (to be requested of house doctor).

A. *Blood.*

1. Full blood count on admission (and..... a week).
2. Wassermann test of blood.
3. Blood chemistry complete (or for.....).

* FORMULA FOR SENNA AGAR FRUIT PASTE

Run through a meat grinder a half pound of figs, a pound of dates and six stewed prunes with their juice. Spread out in a thin layer on bread board and powder in evenly 1 ounce (gms. 32) of powdered senna leaves and 2 ounces (gms. 64) granular agar-agar (Parke, Davis & Co.). Mix thoroughly into a good paste, pack in fruit jar and keep on ice.

Directions: Use a piece the size of a small olive after each meal and once at bed-time if necessary. Reduce the size of the piece and the frequency of taking it as the bowels respond.

† See footnote page 473.

B. *Urine.*

1. Urinalyses, routine, on admission (and..... a week).
2. Urinalyses, routine plus.....
3. Functional kidney test to 'phthalein.
4. Kidney test diet No.....

C. *Feces.*

1. Analysis of stool, routine, on admission (and..... a week).
2. Analysis of stool, routine plus.....
3. Analysis of stool, following Schmidt test diet.

D. *Bile.*

1. Take culture of (A. B. C.) bile on admission (and..... a week).
2. Take quantitative culture of bile for colony counting.
3. Send specimen of (A. B. C.) bile for physiological chemistry.

The usual course of continuous non-surgical biliary tract drainage is between two and four weeks with an average of perhaps three weeks. Continuous drainage is then interrupted and intermittent drainage once, twice or thrice a week is substituted for a period of a month or so when another period of continuous drainage can be given if necessary. The necessities in the individual case is the deciding factor. No definite blanket rules can be given, for so much depends upon the symptomatic response of each patient and the rapidity with which the objective pathological findings clear up.

This method of treatment compares very favorably with the surgical method of drainage of the common or hepatic ducts. Indeed in cases of early catarrh or infection of the gall-bladder *per se*, such as in typhoid carriers or as sequelæ of certain of the acute infections, the non-surgical method of drainage may prove as satisfactory in its end results as the surgical method, *provided* it is demonstrable in each individual that there are present no obstructions to the cystic duct that will prevent the gall-bladder discharging its contents in response to magnesium sulphate.

There are certain very distinct advantages which non-surgical drainage of the biliary tract enjoys that are not possessed by surgical methods. The surgical and anesthetic risks are avoided. The patient suffers no pain as a rule, certainly none that is comparable to and always attendant on that produced by surgery. The drainage as a rule is not only as efficient as judged by the amount of bile recovered, but the length of time that it can be practised is not limited as in surgery to the life of the gut sutures

which control the proper placing of the surgical drainage tube. It leaves no persistent biliary fistula or sinus to annoy the patient and which often requires subsequent surgical repair. No permanent damage is done to the contrary innervation of the gall-tract, and indeed physiological dysfunctions of this delicate mechanism are often improved or made to disappear. It leaves behind it no permanent damage to the ducts producing adhesions as so often follows the direct surgical intubation of the ducts with glass or rubber tubes. It drains the ducts at their most dependent point and collects and removes from the body a larger amount of poisoned bile than does surgery, and thus prevents its passage into the intestines to be later reabsorbed into the portal blood, thus protecting both the intestines and the liver. It is the one method *par excellence* of draining the liver itself which is undoubtedly one of the most important factors contributing to the excellent clinical results obtained by non-surgical biliary tract drainage, probably through its ability to decrease the hepatic toxemia. In this connection alone I should not be surprised that the soundness of this method will be fully established and accepted as a most important measure, and perhaps its scope will be steadily enlarged. In properly selected cases and when properly practised medical biliary tract drainage will do no harm and may prove to be the only measure necessary to insure the recovery of the patient. The *status præsens* of any case as regards the condition of the liver or ducts can be easily estimated at any time by routine daily examinations of the objective cytological and cultural evidence. In any event if this method is not successful or shows no promise of becoming so in any individual case, surgery can always be resorted to.

In what kinds of cases will continuous drainage of the gall-tract be preferable to intermittent drainage?

1. **Catarrhal Jaundice.**—Continuous irrigations of the duodenum with various hot solutions in association with magnesium sulphate stimulations once or twice a day until the mucus plug obstructing the duct is brought away and drainage has become established over a period of several days, when intermittent drainage can be substituted and continued until the pathological objective evidence disappears.

2. **Toxic Arthritis due to a Gall-bladder Focus, Associated with Hepatic or Intestinal Toxemia.**—All extra-abdominal foci of infection should first be removed. Continuous drainage should be practised in courses of from one to four weeks and then interrupted for a month or six weeks, during which period intermittent drainage should be practised once or twice a week.

3. **Typhoid Carriers with Infection Resident in the Gall-tract.**—Continuous drainage for one to four weeks to be followed if necessary (as in arthritis) by intermittent drainages. Frequent cultures should be made, preferably by quantitative methods to determine progress of the case. The bile should remain typhoid-free for at least two weeks with bi-weekly cultures before such a patient can be safely dismissed, and he should report for a re-check-up every month for six months.

4. **Impacted Common Duct Stone of Ball-valve Type.**—The same method of management should be applied here as in catarrhal jaundice. Occasionally the stone will be passed and the stools should be routinely sieved so that it can be recovered and identified and examined for facets. More often the stone bobs back into the dilated common duct. Drainage is continued until the jaundice has disappeared or nearly so, and surgery can be more safely practised. Wherever the recovered stone is faceted surgical exploration is advisable, for there are probably other stones left behind.

5. **Preoperative Cholangitis With or Without Subacute Cholecystitis.**—Continuous drainage here for a few days to two or three weeks will be of essential service to the surgeon in preparing his field of operation, in decreasing the toxemia of the patient affecting the hepatic-intestinal and the cardio-renal systems, and thereby improving the operative and anesthetic risk by reducing the post-operative shock. The general clinical picture will often be found surprisingly improved. The temperature and leukocytosis will drop—often rapidly; the jaundice will disappear more or less rapidly, depending upon the extent of biliary obstruction in the ducts and the amount of intra-hepatic structural damage; the lessened coagulability of the blood will improve; the severity of pain will be materially reduced; the bowel function will be improved; the cardiac irregularity in myocarditis will lessen and the albuminuria and presence of renal casts may entirely disappear. It is too much perhaps to expect to see this effect in every single case, but most patients selected for this form of preoperative management will do well. If the occasional case does not respond to this measure, treatment can be interrupted at any time and surgical procedures carried out. If a given patient is too weak to safely stand continuous drainage at first, intermittent drainage can be substituted for short periods each day, but I have found that it is less effort for the average patient to keep the tube *in situ* than to re-swallow it at frequent intervals.

6. **Postoperative Cholangitis.**—In this condition, and particularly in patients who have already gone through more than one gall-tract operation, continuous non-surgical biliary tract drainage will often be of inestimable value. Indeed, several cases, who have had

as many as five gall-tract operations with repeated relapses and for whom further surgery could not be considered, have not only had their lives saved, but their suffering has been relieved and they have been brought back to a very reasonable state of health, dependent, of course, upon the state of disturbed anatomy and physiology which remains as a relic of their disease and the mechanical measures needed to partially correct it. Certain of these cases have been essentially cured, one, the first case upon whom this method was practised, for over five years. (See Report of Case I.)

If the gall-bladder has already been removed and duct and liver infection or catarrh still remains, I would unqualifiedly recommend that this form of management be carried out as a preliminary trial wherever possible in preference to reoperation, provided it is properly done and is given an adequate chance.

7. Giardia Infections of the Upper Bowel or Involving the Gall-tract.—The purpose of continuous drainage here is to remove from the host as many of the living or vegetative parasites as possible and to endeavor thus to delimit propagation. Various parasiticides, preferably neoarsphenamine, possibly mercurochrome, should be introduced into the duodenum two or three times a week to kill off the remainder. 30 to 60 decigrams of neoarsphenamine in 50 cc of water can be safely used unless it occasions too great a diarrhea. The kidneys should be closely watched and the urine frequently tested for arsenic elimination. In certain cases in which the gall-bladder is probably also infected, as suggested by relapses after treatment is interrupted, final cure cannot be accomplished until the gall-bladder has been resected.

8. In the following groups of cases, also mentioned under the heading of those amenable to intermittent drainage, it may be found that continuous drainage will be the better method.

A. Biliary cirrhosis with or without chronic pancreatitis. Even certain cases of true interstitial hepatic cirrhosis have been improved by this method.

B. Chronic biliousness of various grades.

C. The biliary form of migraine.

D. Hepatic toxemia of various grades, with mental depression ranging into the milder forms of melancholia.

E. Pernicious anemia.

F. Hemolytic jaundice with splenomegaly.

G. Banti's disease may possibly fall within this group.

Practically all of these conditions are of a character for whom our best efforts in the past have proven inadequate or ineffectual. Drainage of the gall-tract has been found to have materially improved many of this group, and in certain instances an apparent cure or certainly a very hopeful arrest in the progress of the disease has been secured.

CHAPTER XXV.

TREATMENT.—(CONTINUED.)

ASSOCIATED MEASURES OF TREATMENT.

IN addition to drainage of the gall-tract, numerous other measures in the *total* management of the case may often be added to advantage. The additional measures which should be selected for the individual patient will depend very largely upon the number and character of the major diagnoses and of the collateral diagnoses which will have been brought out as a result of the complete study or diagnostic survey of that patient.

It is extremely important to bear in mind the truth of what has been already discussed, namely that in so many patients we have to deal not alone with gall-tract disease, but with other associated inflammations, infections, malfunctions and sometimes obstructions of the gastro-intestinal canal (oral, esophageal, gastric, duodenal, pancreatic, ileal, cecal, appendiceal, colonic, sigmoido-recto-anal), together with coincident disease or dysfunction of other important or vital systems of the body (respiratory, cardiovascular, renal, genito-urinary, endocrine, nervous, osseous and blood systems). We must learn to recognize this fact. By improving our methods of *total* diagnosis of a patient we thereby improve our chances of appropriately treating that patient from many angles instead of that of his chief major disease alone. The thoroughness of the total treatment is often the real secret of success.

I admit that this opportunity to completely study each patient cannot be secured in every case and that in many acutely sick and unquestionably surgical patients it is not good judgment to try to do more than is absolutely necessary in the way of differential diagnosis. There is, however, an excellent rule we can follow—to do a complete diagnostic survey of each patient wherever we can, and for the remainder to do as much as we can.

Having done so, we next arrive at a decision as to what general plan of treatment a given patient with disease of the gall tract should be given. In a few uncomplicated cases medical drainage of the biliary tract will alone be required. These are the simplest and easiest types, but unfortunately are too few. In the majority, definite causative etiological factors, often remaining as foci, will be found and these should be eradicated if possible prior to or at

least while undergoing a course of medical drainage. Certain preliminary mechanical or surgical procedures may be required (gums, teeth, tonsils, sinuses) as a preliminary step. Certainly the mouth and upper respiratory tract should be put in the best shape possible. This is a fundamental rule. The general principle of treating the gastro-intestinal canal, is to start at the top and work down, for in our infections (and to a certain extent in our inflammations), we cannot hope to permanently cure any point into which is being drained infected materials from a source higher up. In certain instances it becomes necessary to institute temporary measures of treatment to a portion of the digestive tract lower down, as for instance in cases of rectal fissure and fistula, prolapsed hemorrhoids or acute recto-sigmoiditis.

As already stated, certain cases are selected for necessary surgery of the gall tract; some for immediate operation; some for a preliminary period of medical drainage to then be followed by surgery; and practically all cases so operated should be urged to return for a postoperative check-up medical drainage after six weeks to ensure them the greatest possible chance of avoiding a relapse. Certain of these patients must also be referred back for postoperative medical treatment of other associated disease or dysfunction which was not within the direct field of the operation to correct. This is another important truth that must be better learned.

Permit me now to discuss the associated measures of treatment which I personally am in the habit of using in my cases of gall-tract disease when associated with coincident disease or dysfunction elsewhere. I am presenting measures and methods, which, after a sufficient personal experience, I feel I can recommend. There are certainly many other methods which may be quite as good, but with which I am not personally familiar. I will leave them to be described by their own exponents.

I. Care of the Mouth.—Proper brushing of the teeth should be done at least twice a day, using any good tooth paste which contains potassium chlorate. Emetin and ipecac have not clearly proved their worth, but I have no objection if they are included in the formula of the dental paste.

Thorough rinsing of the mouth should be practised at least twice a day using an astringent mouth wash to squeeze out material from gingival margins, tooth pockets and tonsillar crypts. I prefer for this purpose a solution containing zinc chloride and formalin made up according to the formula on page 301. This mouth wash is pleasantly flavored and is much like the trademarked article, LAVORIS. Where there is a certain amount of oral sepsis present

I urge the patient to gargle and rinse the mouth thoroughly once or twice a day with a solution of potassium permanganate, 1 gr. to the ounce (0.065 gm. to 32 cc) and then diluted one-half with water.

Where the gums are inflamed, swollen or turgid, or retracted and loosened from the teeth, in addition to sending the patient to the dentist for necessary treatment, I request him to swab the gum margins once or twice a day with a solution made up of equal parts of tincture of iodine, glycerine and 50 per cent alcohol. For long continued use I prefer tincture of iodine, 1 part and normal salt solution, 5 parts.

Another excellent form in which iodine can be used is in the following solution. (Talbot's formula.)

Water	℥j	(4.0 gm.)
Zinc iodide	gr. 24	(1.8 gm.)
Iodine crystals	℥j	(4.0 gm.)
Glycerine	℥ij	(8.0 gm.)

This is carefully touched to the dried gum margins and after drying for a few moments it is then washed off with water and spat out.

Among the most usefully important dental procedures in pyorrhoeal infections, a frequent scaling of the tartar from the teeth certainly stands at the top. This should be thoroughly done, going carefully over each tooth many times and then repeated three or four times a year or oftener.

Where the tonsils show only moderate surface infection a daily swabbing out of the crypts and supratonsillar pockets with a freshly prepared 25 per cent solution of silvol or argyrol or a 10 per cent solution of silver nitrate is a useful procedure.

II. Care of the Salivary Glands.—In all patients who are to undergo a course of continuous biliary tract drainage it is important that the above measures for proper care of the mouth be carried out for a few days prior to beginning treatment and continued during treatment. In addition I find it of advantage to make them chew gum or paraffine wax for an hour or two each day to stimulate salivary secretion. This seems to keep the salivary ducts properly drained and will guard against the development of an infectious parotitis. This is a good procedure to carry out in patients undergoing operations on the stomach or gall-tract. Insistence should be made, however, that they spit out all saliva instead of swallowing it in cases where any grade of oral sepsis exists. If the salivary glands become plugged and xerostoma occurs, capsules containing pilocarpine nitrate, gr. $\frac{1}{6}$ (gm. 0.01) and ext. of nux vomica, gr. $\frac{1}{4}$ (gm. 0.015) will be useful. The

heart must be watched carefully when pilocarpine is used. Potassium chlorate in tablets or troches containing 2 or 3 gr. (gm. 0.13 to 0.2) is a valuable drug because of its elimination through the salivary glands. The kidneys require careful watching when potassium chlorate is used over long periods.

III. Nose and Nasopharynx.—As an organ intimately associated with the nose, the eye and its drainage system must be borne in mind. Acute and chronic conjunctivitis and trachoma must be suitably treated by the ophthalmologist. Dacryocystitis, with its intermittent emptying of pus into the nose, usually requires surgical treatment by extirpation of the nasal duct.

In the nose itself surgery may have to be resorted to, to correct deformities of the septum (deviations or spur formations), for removal of polyps and for amputation of the turbinates, where they interfere with free drainage of the sinuses when empyema has occurred.

It is positively necessary to establish free drainage of infected sinuses by surgical procedure, where actual obstruction is present. Resort to the use of suction apparatus in some types of empyema may suffice. Where polypoid degeneration of the mucosa of the sinus has occurred surgery is surely indicated.

Curettage of the fossa of Rosenmüller for removal of adenoid tissue, which may be preventing proper drainage of the middle ear through the Eustachian tube in chronic otitis media, may have to be done. It may, too, be necessary to perform a radical mastoid operation to clear up an old suppurating ear. But before this is done, resort should be had to medical treatment of these old discharging ears, where the perforation in the membrane is of ample size and not of the pin-point type, nor covered over with granulations which would prevent the inflow of medicaments to the middle ear. One must remember that the mastoid cells are usually involved in these chronic running ears and that it is unlikely that any medicine topically applied to the middle ear will very much affect these cells. However, many discharging ears clear up by washing the ear twice a day with Dobell's solution or normal salt solution, drying and then instilling 3 drops of the following prescription:

R—Iodoform	gr. j (0.065)
Acidi borici	gr. x (0.65)
Alcohol (50 per cent sol.)	fl. ʒj (32)

with the patient lying with the diseased ear uppermost and allowing ten minutes for this solution to go through the perforation into the middle ear. No plugging of the external auditory canal with cotton is permitted. Any discharge through the day is wiped away with bits of cotton. During the second week the alcohol is increased

to 70 per cent and during the third to 80 per cent. If this treatment lessens the amount and the odor of the discharge it should be persisted in for four or five weeks, before resorting to operation.

Combined with this, intranasal treatment is required to reduce turgescence of the mucosa by nasal flushing of hot normal salt solution, a pint each day, or we may apply locally to the mucous membrane, every third or fourth day, various strengths iodine solutions such as

R ₁ —Iodini	(gr. viiss)	0.5
Potassii iodidi	(gr. xxiiss)	1.5
Glycerinæ	(3 vi)	24.0
R ₂ —Iodini	(gr. xii)	0.8
Potassii iodidi	(gr. xxxvi)	2.4
Glycerinæ	(3 vi)	24.0

followed by an oil spray containing menthol, thymol, eucalyptol, in various strengths. Occasionally nasal inflation of the ear is resorted to.

Postnasal adenoids and catarrh which may be responsible for the swallowing of pus should be treated by operation or applications of these iodine solutions, or silver nitrate solution 1 per cent to 5 per cent. Fluidextract of red gum, 1 part, in aromatic elixir, 3 parts, in the mild catarrhal states, is a pleasant and efficacious medicament.

IV. Vaccines.—Personally I am still a believer in the use of autogenous vaccines, notwithstanding the controversy still existing in regard to the relative merits of the single strain or the multiple strain bacterium. Particularly am I of this opinion if the autogenous vaccine gives rise to a focalizing reaction reproducing a chief presenting complaint (see pages 499 and 500).

Where possible, however, to secure an autogenous vaccine of the same organism from multiple sources, so much the better. For instance, whenever I recover a streptococcus or a staphylococcus from the gall tract I invariably search back for the presumable source of this infection, and most frequently find it in the tonsils, teeth, gums, sinuses or nasopharynx. When the diseased tonsils are removed I insist that the bacteriologist gets these tonsils promptly from the operator in a sterile Petri dish or a sterile bottle, and the following procedure is carried out at once. The surface of the tonsils is cauterized and each tonsil is cut open longitudinally and 50 per cent of the crypts is cultured, and from 50 per cent of the cultured crypts the same organism or organisms must be recovered before they are used for vaccine purposes. This represents at least a 25 per cent infection of the tonsil. If this organism is of the same family group as that removed from the gall-tract a suggestive connective link has been established. Where

necessary to prove this point animal inoculations for the purpose of determining specificity of types can be carried through, as well as the immunological reactions in the patient's blood.

This same principle is carried out in patients who are found to have a focus of infection in an abscessed tooth root, a nasal polyp or a sinus, and a double or triple vaccine is prepared of the same bacterium or group of them grown out of their different environments. This then represents a multiple strained but autogenous vaccine that, in my experience, has secured for me better results than I have been able to obtain from stock vaccines.* It is much more laborious and more expensive to the patient, but brings better results.

A word more in regard to the teeth. Where the roentgen ray shows focal abscesses or infection of multiple teeth I try to adopt the following procedure for the purpose of practical conservatism. One of the teeth which can best be spared, but which shows *undoubted* root infection, is selected for extraction and is cultured and a vaccine prepared, and injected every five to seven days according to the directions given on page 463. During this period the remaining teeth are given appropriate dental treatment and are re-roentgen rayed at intervals of two months. In a number of cases I have found that the positive evidence by roentgen ray of focal infection in certain of the other teeth has disappeared and those teeth can be saved. The others may then be extracted or the above procedure can again be carried through, and another positive tooth extracted, cultured and a fresh vaccine prepared. To certain patients this conservative plan is of the most vital importance, to others it may appear a waste of time.

V. Special Medication by Mouth.—In the treatment of organic disease of the alimentary tract the best single rule to follow is to avoid the use of all medication by mouth unless there is a definitely proved indication for its use. By this I mean that it is much better to give no medicine at all than to give the wrong drug or combination of them. We should all do what we can to prevent the continuance of oral administration of haphazard chemical therapy. In functional disturbance of the digestive tract perhaps less harm results from haphazard oral medication than in organic disease. I say *perhaps*, because a necessary corollary to proper treatment presupposes a definite knowledge of, or a distinction between, functional disturbance and organic disease. If it is difficult for the specialist in digestive diseases to ascertain this, how much more difficult is it for the general practitioner? It is extremely hard to make this distinction on the basis of history and physical examination alone. Certainly the specialist who studies his cases

* The vaccines are standardized so that 1 cc contains approximately 1000 million of each bacterium.

carefully becomes promptly impressed with the number of patients consulting him, who have gone the rounds and who can present enough prescriptions of various drugs previously given to paper the wall. Among them will be many nauseous mixtures, many of which distinctly irritate mucosal linings, many containing incompatible combinations, and endless proprietary medicines from poor type manufacturing chemical houses who spend the money that should be devoted to their experimental laboratories for glowing advertising propaganda which deliberately fool both the gullible doctor and patient.

Perhaps it is no exaggeration to say that the best source of the kind of referred work which comes to the specialist in digestive diseases is the self-medicated, patent medicine addicted patient or he who has been improperly overdrugged by the careless physician.

As a general rule I find I get much better results by topically treating the stomach or duodenum or bowel by lavaging fluids, some of them medicated (according to the 250 cc unit lavaging system described on p. 307) than I have achieved from the oral administration of drugs. Where topical treatment cannot be carried out I rarely give drugs—never except when absolutely unavoidable—unless I know something definite in regard to the chemistry of the individual patient's digestive tract.

According to the known indications I then select from a list of personally proved efficient drugs which may be classified under these group headings:

1. Digestives.
2. Substitutive gastric products.
3. Antacids.
4. Antispasmodics.
5. Sedatives.
6. Counter-irritants.
7. Symptomatic correctives.
8. Tonics.
9. Laxatives.
10. Substitutive hepatic and pancreatic products.
11. Intestinal antiseptics or drugs exhibiting bactericidal properties.
12. Bacterial antagonists.

1. *Digestives.* If the gastric juice is deficient in quality or quantity due to functional glandular inhibition the following drugs or combinations of them may be employed.

(a) Acidi hydrochlorici dil.	f3ss to j (16 to 32 cc)
Ess. pepsinæ	f3ss to j (16 to 32 cc)
Tinct. gentianæ vel cardamomi comp. . . q. s. ad	f3ij (96 cc)

Directions: One teaspoonful in $\frac{1}{4}$ glassful of water with each meal.

If a tonic drug is indicated Tet. nucis vomicæ (3ss or 16 cc) may be added to the foregoing.

Another way of administering hydrochloric acid is by means of acidulated milk, which can be prepared by adding to a glassful of milk sufficient dilute hydrochloric acid as to cause a frank reaction for free acid to Congo-red paper. In constipated cases, due to hepatic torpor, not only may the gastric secretion be stimulated, but also the flow of bile increased by the use of the dilute nitrohydrochloric acid, in a dosage of from 3 to 5 minims, well diluted and taken through a glass tube after the meal. For this purpose, and as a tonic, for those cases of gastritis secondary to a prolonged acute infection, the following prescription of Hare's is an excellent one:

R.—Acidi nitrohydrochlorici dilutæ f3j vel. f3ij (4-8 cc)
 Tinctura nucis vomicæ f3j (4 cc)
 Tinet. cardamomi comp. f3ij (64 cc)
 Tinctura gentianæ compositæ q. s. ad f3iv (128 cc)
 M. S.: One teaspoonful (4 cc) is to be taken well diluted with water after meals.

Aside from its effect as a gastric stimulant and as an excitant of the hormone secretion, it is a generally accepted fact that the administration of dilute hydrochloric acid in the dosage commonly employed is entirely ineffectual as an active agent in gastric digestion. In this regard it has been stated (Sippy) that it requires approximately 100 drops of dilute hydrochloric acid to aid in the digestion of 15 gm. of albumin. Therefore, with a patient on a diet calling for 100 gm. of protein, it would require 600 or 700 drops of the dilute hydrochloric acid. This amount cannot be administered except by means of the stomach tube.

In an acid gastritis, where the administration of acids is not well borne, they should be withdrawn and the gastric state kept alkaline with bicarbonate of soda or other antacids, the diet being arranged upon a plan suitable for intestinal digestion, which sometimes may be aided by the use of takadiastase, pancreatin (preferably pancreon), or inspissated bile salts in a dosage of 5 to 10 gr. (0.6 to 1.2 gms.) given after meals. There are various preparations, such as oxyntin, acidol tablets, gastrinin, and similar well-advertised preparations which have no especial advantage over the official dilute tincture of hydrochloric acid, besides being considerably more expensive.

(b) *Essence of Caroid*. Caroid is derived from the bark of the female pawpaw tree and possesses an enzymatic property for proteins and is a good solvent for gastric (or duodenal) mucus. I find it useful for many patients who are unable to tolerate or properly digest milk and use it in teaspoonful (4 cc) amounts to each 6 oz. of milk. It will give a good test-tube demonstration in first precipitating the milk casein into fine curds and later digesting it and transforming it into whey. Similarly it will experimentally partially digest egg albumen. The powdered caroid in a dosage

of gr. iij (0.2 gm.) may be used instead of the essence. Both of these forms are useful in catarrhal gastritis on account of the solvent action on mucus. The caroid may be combined with charcoal or with soda bicarbonate where a mild antacid action is desired.

I find that the American Ferment Company's product has been very reliable.

2. *Substitutive Gastric Juice Products.* Such medication is necessary in atrophic gastritis or complete chemical achylia.

The best preparation I know of is the so-called Gastron prepared by Fairchild. This is said to be an extract made from the total mucosal secreting surface of the stomachs of pigs. I have found it to contain active digestive enzymatic action and prefer it to the administration of large doses of hydrochloric acid and pepsin and as a rule I find that it is better tolerated. I prescribe it in $\bar{3}$ ij (8 cc) doses in a glassful of water to be taken in thirds at the beginning, the middle and end of each meal. Oxyntin powder (Fairchild) is a tasteless product prepared from the acid secreting cells of the stomach that appeals to the fastidious patient but is expensive. It is given with the meals in gr. v (0.3 gm.) dosage.

Nitrohydrochloric acid (although strictly speaking not of this group) is a useful drug in achylia, acting perhaps better as a hepatic secretagogue than a gastric digestant. It should be freshly prepared and prescribed in the concentrated form in a dosage of from 3 to 5 drops (0.2 to 0.3 cc) in water through a glass tube after meals.

3. *Antacids.* I believe that better results are secured by the use of repeated *small* doses of a mixed alkaline powder taken after meals than by the larger single doses ($\frac{1}{2}$ to 1 teaspoonful) of soda bicarbonate or other alkalies. My observations have confirmed the experimental work of Crohn (1) who has shown that although the larger doses of soda bicarbonate, magnesia oxide and bismuth will promptly reduce the acidity, nevertheless it is shortly afterward followed by rebound in the total acid values to a level higher than before; that the promptness of the neutralizing effect and the level of secondary acid rebound as applied to the three antacids mentioned occurs in the order in which they are mentioned; and, finally, that by combining these three agents and administering them in smaller and repeated doses that the neutralization is longer sustained without the secondary acid rebound.

The combination of flavored antacids which I prefer is a 1-2-4 mixture as follows:

Ol. menthæ piperitæ	$\mathfrak{M}\text{xvj}$ (1.0 cc)
Sodii bicarbonatis	$\bar{3}\text{ij}$ (8 gm.)
Magnesiaæ oxidi ponderosa	$\bar{3}\text{iv}$ (16 gm.)
Bismuthi subcarbonatis	$\bar{3}\text{j}$ (32 gm.)

Sig.—One-quarter teaspoonful to be taken with water at thirty, sixty and ninety minutes after meals.

By weight this amount of powder is roughly 11 gr. which means that the patient will receive $1\frac{1}{2}$ gr. of soda bicarbonate, 3 gr. of heavy oxide of magnesia, and 6 gr. of bismuth subcarbonate.

Equivalents. The more accurate way of prescribing by weight is to have this powder put up into "No. one" capsules packed tight and an extra portion taken up in the cap of the capsule. This is equivalent to 11 gr. of the powder. If a double dose is desired it can be packed in a "double naught" capsule, which will hold 22 gr. of this powder.

On account of the additional cost of preparing a capsule prescription for poor patients in the clinic the powder can be furnished in a box, and they can get a rough equivalent of 11 gr. by covering a ten-cent piece to a flat level and placing on the tongue dry or with a swallow of water. In this case the Sig. to this same R_x is written: A "dime dose" to be taken at thirty, sixty and ninety minutes after meals.

4. *Antispasmodics*. Into this group fall belladonna (and its alkaloid, atropine) and benzyl benzoate.

Belladonna in the form of the tincture is a most useful drug for decreasing the amount of the gastric secretion and in the control of pylorospasm. For these purposes I prescribe it in ascending dosage in water before meals, starting with 10 drops (0.6 cc) and increasing 1 drop each time taken until a definite physiological effect is secured (blurred vision, dry mouth, flushed skin, rash), when the dose is reduced 3 to 5 drops and continued for one to two weeks.

When dealing with a delayed gastro-duodenal transit time in an attempted duodenal intubation, the element of pylorospasm can often be differentiated from mechanical difficulties due to inflammatory edema, new growth or adhesions by introducing through the tube 20 drops (1.2 cc) of the tincture of belladonna or subcutaneously giving an injection of $\frac{1}{100}$ gr. (0.0006 gm.) of atropine sulphate. The latter is the more effective. If this fails to secure prompt entrance of the duodenum within twenty minutes it is wiser to discontinue for the day and repeat the attempt after three or four days of ascending doses of tincture of belladonna as described above, supplemented by an injection of $\frac{1}{150}$ gr. (0.0004 gm.) of atropine immediately before the second attempt. Where such a procedure fails it is diagnostically probable that the inability to enter the duodenum is due to factors other than pylorospasm.

Benzyl benzoate, I have found to be less constant in its control of gastric, duodenal and gall-duct spasm than was hoped. One cannot predict its effectiveness in any individual case. It will act well in one and fail in another symptomatically identical case. In my personal experience I have found its action more constant in the relief of colon spasm. For the latter purpose a dose in the

amount of 20 to 30 drops (1.2 to 1.8 cc) well diluted in hot water, taken at bed time and again on rising in the morning, will usually suffice as a temporarily corrective measure.

5. *Gastric Sedatives.* In the group of drugs, orally administered, which fall within this classification I make use of only three:

Bismuth, preferably the subcarbonate, in capsules of 10 gr. (0.6 gm.) or powders containing 20 gr. (1.3 gm.) taken preferably before meals when the stomach is nearest empty. When used as an antacid it may be combined with soda bicarbonate and heavy magnesia oxide, as on p. 476, and should be taken after meals.

Cerium oxalate will sometimes act well as a gastric sedative in 3 to 5 gr. doses (0.2 to 0.3 gm.). It may be combined to advantage, in certain cases, with bismuth. In controlling nausea, I have found cerium oxalate very disappointing in many cases, though helpful in some. It is worth trying even though it often fails.

Chloretone, a proprietary name applied to chlorbutanol, when given in 3 to 5 gr. (0.2 to 0.3 gm.) capsules after meals will often relieve gastric distress where other drugs fail, acting as a local anodyne. It should be used with caution and not continuously over long periods.

A combination of these drugs with soda bicarbonate may be found useful in patients with gastric hyperesthesia or so-called gastralgia, as follows:

R—Cerii oxalatis	gr. v (0.3 gm.)
Bismuthi subcarbonatis	gr. x (0.6 gm.)
Sodii bicarbonatis	gr. xx (1.2 gm.)

Ft. Charta No. I.

Sig.: Suspend the powder in 1 ounce of water and take after meals and at the time directed.

6. *Counter-irritants.* The one drug, orally administered, which I find useful as a counter-irritant is nitrate of silver. I confine its use to patients who have gastric erosions or superficial mucosal ulcer, who have persistent pain, or to patients with functional subacidity. It seems to stimulate not only repair of cellular tissue, but also appears to encourage cellular function. I prefer to administer it according to a plan suggested by Lockwood.(2) He recommends the following prescription.

R—Argenti nitratis	gr. 16 (1.03 gm.)
Aquæ destillati	℥ ij (64 cc)

M. Sig. Five minims equals gr. $\frac{1}{6}$ (0.01 gm.); give 15 to 25 minims (0.9 to 1.5 cc) in distilled water thrice daily, one-half hour before eating.

Lockwood recommends using this in nine-day cycles as follows: "The first three days give 15 minims, which equals $\frac{1}{2}$ gr. (0.0325 gm.), three times a day; the second three days give 20 minims or $\frac{3}{4}$ gr. (0.04875 gm.) three times a day; for the next three days give 25 minims or $\frac{5}{6}$ gr. (0.05416 gm.) three times a day. Any resulting

diarrhea should be met by reducing the dose or entirely withholding it."

Silver nitrate must always be administered with caution and never over long continued periods unless the patient is under close and frequent observation of the physician. The patient should be especially admonished never to renew this prescription without a direct order from the physician, and, as a further check, the doctor should warn the druggist that this prescription is not to be refilled. I have seen a number of cases of chronic silver poisoning (argyria) which have resulted from negligence in this respect on the part of the physician.

7. *Symptomatic Correctives.* There is very little oral chemical therapy that I find useful in this group.

(a) *To promote belching* in patients who have oppressive distention of the stomach the simplest, and perhaps the most effective, and certainly the most commonly used household remedy for this purpose is to give 10 to 30 drops of aromatic spirits of ammonia (0.6 to 1.8 cc) and $\frac{1}{4}$ to $\frac{1}{2}$ teaspoonful of soda bicarbonate (1 to 2 gm.) in half a glassful of hot water.

A favorite combination of the late John H. Musser for this purpose, consists in the following prescription which I have found useful:

R—Cresoti	℥ 24 (1.5 cc)
Sodii bicarbonatis	℥ ij (8.0 gm.)
Spts. ammon. aromatici	℥ vi (24 cc)
Spts. chloroformi	℥ 48 (3.0 cc)
Liq. sodæ menth.	q. s. ad ℥ ij (96 cc)

M. Sig. Shake well before using and take 1 teaspoonful in one-half glassful of water when distressed with gas on stomach.

(b) *To Allay Nausea.* The use of cerium oxalate and bismuth as described on p. 478.

(c) *To Relieve Pain.* The use of the sedatives described on p. 478, of silver nitrate as described on p. 478, when the gastric pain is due to hyperacidity or pylorospasm or cardiospasm and, to a certain extent, entero-colon spasm. When pain is very severe, as in gall-stone colic, nothing is so effective as the hypodermic administration of morphine sulphate in doses of gr. $\frac{1}{6}$ to $\frac{1}{4}$ (0.01 to 0.015 gm.) to be repeated if necessary.

Enterospasm, associated with acute diarrhea, when not controlled by belladonna or benzyl-benzoate, may be relieved by an initial full dose of castor oil (unless the appendix is involved), to be followed by teaspoonful doses every half hour of the following mixture repeated four to six times.

R—Tinct. opii camphorati	℥ iv (16 cc)
Bismuthi subcarbonatis vel subgallatis	℥ ij (8 gm.)
Mist. cretæ	q. s. ad ℥ iij (96 cc)

8. *Tonics.* As a general rule, the simpler they are, the better. In *liquid form* I frequently use:

(a) R Syr. hypophosphitum comp. (N. F. IV) f℥ vi (192 cc).
Sig.—Take 2 teaspoonful in water before each meal, thrice daily.

This is very similar to Fellows' well known Compound Syrup of the Hypophosphites.

(b) R Elix. glycerophosphatum comp. (N. F. IV) f℥ vi (192 cc).
Sig.—Take 2 teaspoonfuls in water before each meal, thrice daily.

This is very similar to Smith, Kline & French Company Elix. Neurophosphates, except for the coloring matter.

(c) R Liquor ferri peptonati et mangani (N. F. IV) f℥ vi (192 cc).
Sig.—Take 2 teaspoonful in water before each meal, thrice daily.

This is very similar to Gude's well-known Peptomangan.
In *capsule form* I frequently prescribe:

(a) R—Strychninæ sulphatis	gr. 1½ (0.08 gm.)
Acidi arsenosi	gr. 1 (0.06 gm.)
Aloini	gr. 6 (0.4 gm.)
Ferri reducti	gr. 48 (3.0 gm.)
Calcii hypophosphitum	gr. 96 (6.0 gm.)

Div. in capsulas No. 48.

Sig.—Take one capsule, thrice daily, before meals.

(b) R—Extr. nucis vomicæ	gr. 7 (0.48 gm.)
Acidi arsenosi	gr. 1 (0.06 gm.)
Ferri reducti	gr. 48 (3.0 gm.)
Calcii hypophosphitum	gr. 96 (6.0 gm.)

Div. in capsulas No. 48.

Sig.—Take one capsule before each meal thrice daily.

This may often be substituted to advantage where strychnine is poorly tolerated.

Tonic-sedative. It sometimes is of advantage to combine a sedative action to a tonic, and I find frequent occasion to use the following:

R—Liq. potassii arsenitis	f℥ ss (2 cc)
Tr. hyoscyanii	f℥ i (4 cc)
Tr. nucis vomicæ	f℥ iv (16 cc)
Sodii bromidi	℥ iii (12 cc)
Elix. aromatici vel elix digestivum comp. q. s. ad	f℥ iii (96 cc)

Sig.—Take one teaspoonful in water, thrice daily, before meals.

9. *Laxatives.* I find very little necessity for prescribing laxatives except as a temporary expedient in the occasional case.

When a single brisk purge is needed, ½ to 1 oz. (16 to 32 cc) of castor oil, although often distasteful, is my first choice. Its unpleasant taste can usually be well disguised at the average drug store soda fountain or by well-known home expedients.

Where a cholagogic action is desired for occasional use, I rely chiefly on divided doses of calomel in $\frac{1}{8}$ or $\frac{1}{10}$ gr. (0.01 to 0.006 gm.) to a total of 1 to $1\frac{1}{2}$ gr. (0.06 to 0.09 gm.), to be followed six to ten hours later with $\frac{1}{2}$ to 1 oz. (16 to 32 cc) of a saturated solution of Epsom salts, or 2 to 4 teaspoonfuls of the crystals of this salt dissolved in half a glassful of water, and taken before a meal. Or instead half a bottle (about 3 oz.) of citrate of magnesia may be substituted.

If a mild continued laxative effect is desired for a few days, especially in a patient with hyperacidity, 2 teaspoonfuls (8 cc) of milk of magnesia may be given after each meal, or a few doses of the antacid powder mentioned on page 476 may be tried.

Wherever possible I try to avoid the giving of laxative prescriptions in large amounts, for instance 100 pills, for this simply encourages the patient into developing a laxative habit, which, in turn, will increase the state of constipation. Occasionally, however, pills containing aloin, phenolphthalein, belladonna, strychnia and cascara will serve a useful purpose as a temporary measure.

It is probably next to impossible to practise medicine without using chemical laxative therapy from time to time, yet its wide and indiscriminate use over long periods has materially contributed to the chronic digestive ill health of thousands of people, living in the complex and highly artificial civilization of our day. It is pitiful to see the toxic results which follow in the train of a well formed constipated-laxative-habit vicious circle. To break this is difficult, but helpful, and often curative results can be secured by following the suggestions in Chapter XXIV, page 463, and those in the later sections of this chapter.

10. *Substitutive Hepatic and Pancreatic Products.* In cases with proved achylia gastrica, chronic pancreatitis, or deficient pancreatic enzyme action, and torpid livers, the use of pancreatic tissue and bile salts certainly has a therapeutic place. This has come about not as a result of empiricism, but following the accumulation of much experimental evidence.

There are a host of such products on the market, most of them similar, and nearly all proprietary combinations exploited by the large pharmaceutical manufacturers as a cure-all for liver and digestinal diseases. Used in such a way their effect is as pernicious as the indiscriminate use of laxatives. Used as temporary adjuncts, aiding in the necessary readjustments in habits of living and combined with topical and technical treatment as outlined in this book, they have a distinct place.

It is impossible to mention them all. My personal experience has been largely with Pancrobilin, plain (which I prefer to the stronger laxative variety); Caroid and bile salts; verocholate;

taurocol; glycotauco. There is very little to choose between them. Pancreatin, or pankreose, or pancreon in 2 to 5 gr. (0.12 to 0.3 gm.) dosage, or taka-diasatase in $2\frac{1}{2}$ gr. (0.15 gm.) amounts, either singly or combined in capsules will be found useful, at times, in helping to correct a proved pancreatic enzymatic deficiency, especially when there is an associated gastric achylia.

Such alkaline products are rendered partially inert if passed through an acid stomach, and various expedients to obviate this, such as coating the capsules with salol or keratin, have been tried, but the results are uncertain unless the pharmacist is very expert and the labor involved greatly increases the cost of the capsule.

Such capsules are best given two and one-half to three hours after the meals.

11. *Intestinal Antiseptics or Drugs Exhibiting Bacteriacidal Properties.* In this class of drugs, serious over-exploitation has occurred for years, and each year sees the marketing of a new crop. The ideal intestinal antiseptic has not yet been developed.

Salol in 5 gr. (0.3 gm.) tablets and ichthyol, (although expensive) gr. 2 to 3 (0.12 to 0.15 gm.), in capsules, taken before the meals, thrice daily for a short period, I find are, in general, the most reliable ones to prescribe. But little can be expected from such "drop in the bucket" therapy.

Walker's new phenol derivative, called Dimol, is the latest intestinal antiseptic to be widely exploited, but it may suffer the same fate as his Trimethol, equally enthusiastically advertised several years ago. I have tried it as a transduodenal enema, but am still doubtful as regards its effectiveness and its reliability. Furthermore, it is much too expensive.

12. *Bacterial Antagonists.* Somewhat the same state of uncertainty exists in regard to the usefulness of these agents. I believe, however, that this is a saner experimental direction to work in and a uniformly successful method may be finally produced.

The three most important agents now used are:

(a) *B. acidophilus* given in whey or broth cultures, by mouth, by duodenum, and by rectum, and *B. acidophilus* milk. Most of the experimental background to its rationale has resulted from the work of Rettger, Chaplin, Vorhaus and others. Reference should be made to the excellent review of the subject in the recent book by Rettger and Chaplin. (3) I have tried out this agent with some thoroughness, by mouth and by duodenal and rectal implants of the cultures, and by long continued use of the milk, and a number of good results have been secured, the best, however, when combined with other measures, such as gall-tract drainage, transduodenal lavage or enema, and colonic irrigations after Shellburg's and Norman's method. Although *B. acidophilus* is of distinct assistance

in simplifying a pathogenic intestinal bacterial flora, I am still in doubt as to whether it can continue to exist in the human intestine unaided by diet, lactose, etc., or unless frequently replanted. It may eventually have to be placed in the same pigeon hole with *B. bulgaricus*, which had its vogue a decade earlier.

(b) *Vaccines* prepared after careful bacteriological isolation and identification of pathogenic groups cultured out of the feces. These are given both subcutaneously as a killed culture, or intrarectally as a living culture. I have had too little personal experience with this method to be qualified to speak, although Bassler and others appear to think highly of it.

(c) *Entero-antigens*. I have had no personal experience with this method recently developed and praised by Cotton, Draper, Satterlee and others. They have reported promising results which will bear watching.

VI. Colonic Irrigation.—In certain cases in which the colon is found to be definitely infected (colitis of various types), and especially when it seems to be acting as a focal point of infection, colonic irrigation for drainage of the colon must be instituted. This procedure, when properly done, is far different from the so-called high enema. It requires special apparatus, handled by someone who is expert with the procedure. When a colonic irrigation is improperly given it not only produces unnecessary discomfort to the patient, but may do actual damage. Home enema habits, particularly when given by such devices as some of the cascade sprays extensively advertised, sometimes create a very pernicious state of affairs when left to the discretion of the patient.

For the irrigating fluid I believe that there is nothing better, certainly nothing safer, than plain tap water, provided its source is known to be good. I have used solutions of silver nitrate, potassium permanganate, tannic acid, Dimol and many others, in strengths varying from $\frac{1}{15000}$ to $\frac{1}{5000}$ together with solutions of starch water (10 per cent) and I question whether the end results are as good as when plain water alone has been used. I believe that thorough drainage of the colon with water, followed by the introduction of bacterial antagonistic implants, may prove more efficient in overcoming a colonic focal infection than can be accomplished by the use of the disinfectants mentioned above.

VII. Exercise.—Many patients who are in chronic ill health from gastro-intestinal disease or disorder can be brought back to a much higher plane of health if safely graduated, systematic exercise is prescribed for them as they are beginning to improve. I have found that much additional help can be secured for such patients if a physical culture expert can be found who will coöperate intelligently with the doctor.

No blanket rules can be laid down. Each patient should be individualized and the proper group of exercises outlined with due appreciation of what that patient can be safely given, paying particular attention to the cardiac action, blood-pressure, etc. These exercises can be roughly grouped as rebuilding of tissue, retoning of muscle, relaxing, reducing and eliminative. Many patients are already used to taking setting up exercises, but are found to be doing them wrong. Many who have over-emphasized retoning muscles have become muscle bound, and need to be taught relaxing. Later on proper outdoor exercise should be encouraged, but the type advised should be likewise individually selected for each given patient.

VIII. Hygiene.—In connection with exercise, a proper hygiene should likewise be emphasized. Many people representing the group of the chronic invalid should be encouraged to adopt the morning cold plunge or shower. Many say they cannot because they do not react properly. The majority of them can be taught to do so. To react from a cold bath, the temperature of the room should always be several degrees warmer than the temperature of the water. Many people say they cannot react to a cold bath because they take a tepid bath and step out into a bathroom improperly heated.

As an aid to securing the proper reaction I have found the use of a "salted towel" helpful. Have the patient buy 25 pounds of sea salt, soak a *rough* Turkish towel in a pail full of sea-salt brine, dry the towel rapidly before the kitchen fire or radiator so that the salt crystallizes rapidly and is enmeshed in the towel. Rubbing down briskly with this will often reestablish the circulation.

Plenty of fresh air, especially in the bedroom at night, is an essential in simple hygiene, which is often found neglected and must be prescribed. Sun baths are extremely useful.

IX. Rest.—Certain patients must have complete or modified bed rest, preferably under hospital supervision, for several weeks before active topical or technical treatment can be safely applied. (See Report of Case XXI.) Their strength must be conserved—not overtaxed. Often this requires a nice judgment of the individual patient.

Certain of them must have general *visceroptotic rest cure* management, made up of the following items:

(a) *Elevation of Foot of Bed.* Starting with 4 inches and increasing 4 inches every second or third day until an elevation of 16 inches had been reached. This must be done gradually to prevent the patient from becoming dizzy or headachy.

(b) *Wearing of a Proper Abdominal Support.* I prefer applying an adhesive plaster bandage after the manner recommended by

Dr. Rose, using his soft moleskin plaster manufactured by Johnson & Johnson. It must be emphasized that no abdominal support is really efficient unless the uplift is exerted *inside or within* the iliac crests. Any support that encircles the iliac crests loses much of its efficiency. In many asthenic visceroptotics the level of the abdominal wall is $\frac{1}{2}$ to 1 inch *lower* than the crests of the ilium. Therefore it is obvious that the support must exert its uplifting pressure within the crests. Hence the failure of many types of so-called supporting binders or corsets. I have proved this many times by roentgen ray.

In addition to this support I have the patient fitted with a Curtis abdominal pad (designed, I understand, by Sir Arbuthnot Lane), which I find the most efficient, due to its patented hinge. Its cost, however, is too high, and for this reason I often order an Amsterdam or Sauer pad, which next approach it in efficiency.

These pads must be adjusted while the patient is lying in bed with the hips elevated and must be worn *whenever* the patient steps out of bed for any purpose. This is most important, for I find that five or ten minutes with an unsupported abdomen will offset many days of bed rest in the Trendelenburg position.

These temporary measures of abdominal support are only necessary until body weight is built up, (which means increase also in peritoneal fat), and until the abdominal muscles have been strengthened by exercise.

(c) *Weight Building*. Most of these patients are very poorly nourished and some method of forced feeding must be used. Associated with the ptosis there is usually gastric atony (often gastrointestinal atony), and anorexia or capricious appetite. Five or six small meals a day are much better than three full meals. The patient must be encouraged, often coaxed, to eat. An appetizing tonic, such as tincture of nux vomica and gentian will help. Sherry or whiskey added to milk and eggs is often of great aid. At least 3000 calories should be given if possible. There are many diet combinations. One thing is necessary, however, namely to avoid monotony in diet. Offer a variety of combinations from which selections can be made and cater to the individual likes and dislikes of the patient. Variations in selection of permissible foods must be made according to the associated or collateral diagnoses made out by the total survey. Twenty to 40 pounds can be gained and *kept* in four to six months' time. The following diet is my usual choice:

Breakfast. A cooked cereal, such as farina, wheatena, cream of wheat or hominy may be eaten with cream and sugar. Oatmeal may be allowed, if very thoroughly cooked.

An occasional lamb chop or slice of breakfast bacon.

Two soft boiled or poached eggs.

The soft parts of bread, crackers, or freshly made toast, may be eaten with butter.

Milk, malted milk, or cocoa may be taken. It is better to avoid both tea and coffee.

10 to 11 A.M. The choice of cream and rice water formula, malted milk.

Koumiss, Kaffir or buttermilk, or equal parts of milk and cream, junket or cup custard.

One or 2 raw eggs may be substituted, or added to any of the foregoing. Crackers and butter.

Luncheon or Dinner. Chicken or fish in any form but fried, broiled squab, or breast of guinea hen. Broiled or boiled beef and lamb to be run through a grinder when cooked.

Milk toast.

Oysters in any form but fried.

Potatoes in any form but fried, preferably mashed or baked.

Peas, lima beans, spinach, squash (to be put through a colander and puréed with cream), boiled rice, tender string beans, buttered beets, creamed carrots or the tender ends of asparagus or cauliflower, spaghetti or macaroni.

A salad of plain lettuce with French dressing (with the amount of vinegar reduced) may be permissible every second or third day, if desired. Bread and butter.

Choice of junket, cup custard, blanc mange, tapioca, rice, corn-starch, or bread puddings, floating island, and vanilla ice cream, if held in the mouth until warmed to body temperature.

4 to 5 P.M. The same choice as 10 A.M.

Supper or Dinner. Thick soups, such as rice, sage, barley, potato, or asparagus, or creamed purées of beans, peas or lentil, which are to be run through a colander. No soups made from meat or meat stocks are allowed.

One or 2 soft boiled or poached eggs. Bread and butter. Milk or cocoa, and the choice of any of the above desserts, except ice cream.

Before retiring the choice of the foods allowed at 10 A.M.

AVOID.

Fried, greasy foods, pies, cakes, candy, hot-cakes, mustard, pepper, vinegar, pickles, onions, coarse breads, and all fruits.

Prepare food properly; cut up food finely; eat slowly; chew thoroughly. Remember you have no gizzard.

(d) *Breathing Exercises.* Many visceroptotics do not properly use their respiratory organs, they breathe badly and therefore fail

to properly oxygenate their blood. Because their blood is impoverished they "feel" the cold, are afraid of "drafts," and shut themselves up in badly ventilated rooms.

In the visceroptotic much of the total blood supply is locked up in the splanchnic circulation. Such patients are figuratively drowning in their own blood; their mesenteric bloodvessels are over-filled, and, due to the ptotic abdominal viscera, too little blood is pushed through the portal system; the stagnant venous blood carrying poisonous products drained from the intra-abdominal organs accumulates; the toxic dose carried to the liver is greater than can be successfully filtered out by the hepatic cells, and hepatic toxemia ensues. Such blood as passes through the liver reaches the right side of the heart still poisoned, and, passing through the pulmonary circuit, is insufficiently oxygenated and reaches the arterial pumping station in the left heart still impure.

And so the vicious circle revolves endlessly. Chemically impure blood pumped out of a tiring heart to impoverished tissues and toxic organs, thence through a functionally overworked filtration plant (the liver), and again back to insufficiently exercised lungs and overworked heart.

We can help to break the circle at two points. First, by forcing more blood through the portal circulation, by elevating the foot of the bed and supporting the abdomen as mentioned above. Second, by attempting to increase the oxygenation of the blood and thus increase its purity. To do this I have the patient's bed or chair placed near an open window, and, with the patient well blanketed, have her take twenty full inspirations and exhalations through a quill tooth pick. She must be taught *how* to breathe deeply and slowly. Each day ten to twenty deep respirations are added until a reasonable limit has been reached. The quill tooth pick has both points cut off, leaving the piece of tubing. This is placed between the closed lips and through it the patient breathes. This I use for two reasons, first, because I feel they can get more air in by this means, and, second, and more importantly, in order to make them really do the exercises. Some years ago I found that give them the quill or other tube to breathe through and they "play the game," but with no quill I found them shirking the practice. Later on the open air bridge or sun porch rather than the window makes the patient do more.

The end-result is that by increasing the lung capacity and the oxygen dose, the blood is enriched, the tissues and organs become better nourished, cellular death is less active, and therefore poisonous products split off and carried to the liver diminish, and the vicious circle is gradually broken. Later on rebuilding of tissue and retoning of muscle must be more vigorously undertaken.

X. Elimination.—Proper elimination must be secured through the skin, kidneys and bowels. I have indirectly touched, on elimination through the skin by bathing and exercise. Sweat baths, vapor baths, etc., are useful for the sthenic and circulatory hypertension cases, but should be avoided in the asthenics.

The functionally disturbed kidney needs little else than water, which, when properly used, is the best diuretic. The structurally damaged kidney must be treated according to the type and the individual indications.

XI. Treatment of the Constipated Patient.—We must first determine whether the patient has an atonic or a spastic gut. The general character of the history plus close observation and study of the stools will usually tell us. Roentgen-ray diagnosis will often help.

If atonic, the first duty is to build up the patient in general. Since the patient is usually *let down*, iron or arsenic or glycerophosphates, singly or combined, and given by hypodermic injection, are usually indicated, combined with a daily warm bath followed by the cool spray, or cold wet towel slapping or salt towel rub. The patient should secure at least ten hours rest in bed out of each twenty-four. If ptosis is associated, and frequently it is, the foot of the bed should be elevated. The diet must be bulky and have much “roughage” in it, so as to leave considerable intestinal residue or waste to stimulate the tone-deficient colon.

If spastic, the diet should be bland and simple and of a type readily burned up without leaving intestinal “clinkers.” Sedatives and antispasmodics should be given.

In either type, regularity of attending the toilet is of fundamental importance. The patient should select the time of day, morning or evening, when he is least hurried, and make it a point to go to the toilet at that hour. He should spend at least thirty minutes in such an effort each day, whether successful or not. By this means the mind is brought into play and a neglected natural reflex is reëducated. He should not take anything with him to read to distract his mind during this initial period of bowel reëducation. Anything more than moderate straining should be avoided. If a successful bowel movement is not secured at the expiration of half an hour of genuine concentration on this function a suppository may be used occasionally.

Under no circumstances should any purgative pills be given if the laxative habit is to be broken. In the occasional patient a dose of castor oil once a week may have to be resorted to for a short time where obstinate constipation exists. I find that the senna fruit paste formula mentioned on p. 463, is a very useful preparation to use in the beginning. After a short period the

fruit mixture can be made up again omitting the senna, and in the spastic case the agar also should be left out of the formula. Mineral oil is most useful in the spastic form of constipation. Oil enemata may occasionally have to be used in obstinate cases of atonic constipation to overcome fecal impaction. Bran may be useful, but only for the atonic type. One to 2 glasses of water taken immediately on arising is helpful, hot water for the spastics, cold for the atonics.

The ptotic and atonic organs should be supported until, by graduated exercises, which are taught the patient a few at a time, combined with electricity and massage, the muscles of the abdominal wall begin to get back their abdominal tone and support the abdominal contents as Nature intended they should.

Graduated abdominal exercises, according to the methods so well worked out by Dr. John Bryant of Boston, should be carefully studied and applied.

Now a word as to the use of electricity. This is administered in two ways. The high frequency in the atonic type is applied in a stimulating or sparking way to the lower thoracic and lumbar spine for from ten to twenty minutes, so that many sparks are showered onto the skin; while in the spastic form of constipation we endeavor to produce sedation by keeping the applicator in close contact with the skin, and using a current of the highest possible frequency, and therefore one with a very narrow gap, so that only warmth is noticed by the patient. This application may be extended around the side of the abdomen to pass directly over the descending and transverse colon. Intrarectal applications are mentioned only to be condemned, as I believe their danger far outweighs their efficacy. The Morse sine wave motor is used in both types, but the best results are secured in the atonic cases. I very much doubt that this form of electricity really does produce contractions of the intestines; but it does bring about a very definite and painless contraction of the abdominal muscular wall at regularly recurring intervals. The muscular work done is increased by placing sand bags to any weight required—5 to 20 pounds—over the wet asbestos pads, which are the applicators in this type of machine.

The patient must be taught to eat regularly and properly without the skipping of meals, and a restriction of fluid intake for at least two hours after meals should be enjoined in the atonic type. Where ptosis is an associated factor the diet is of paramount importance, but must be suitably modified to meet the collateral or minor diagnostic findings of each individual case. It is important to emphasize this fact, that the patient with spastic constipation should not be given a diet containing bran, shells of corn, peas or

beans and uncooked cellulose; do not habituate either the spastic or atonic constipated patient to the use of purgative pills or he will eventually seek the services of a Christian Science practitioner.

Apropos of the mental causation of sudden and obstinate constipation, sometimes grouped under the misnomer of hysterical dyschezia, I have in mind the following case: A young, impressionable Jewish girl, aged sixteen years, was more than usually devoted to her father. She was being sent away to a girl's summer camp in Maine and was in the Grand Central Station in New York under the care of the camp chaperon and in company with the other girls waiting for her father to bid her good-bye. He was unavoidably detained. Her train was called. She refused to go without first seeing her father. The chaperon insisted upon getting her aboard the train. The girl went into an hysterical temper, screamed, kicked, wept copiously and worked herself into a most disorganized nervous state. Prior to this morning her intestinal function had been properly normal, with one or two bowel movements each day without laxative help. Following her exhibition of temper, which apparently upset the equilibrium of her sympathetic nervous system, her bowels did not move for twelve days, notwithstanding an active camp life and the use of enemata and all manner of laxatives. During this twelve days' period of intestinal inactivity she complained of marked abdominal distention and soreness, headaches, dizziness and marked flatulency, but neither of nausea nor vomiting nor anything else suggesting intestinal obstruction. The first stool passed was described as "enormous" and the patient stated that her weight was reduced from 118 to 110 pounds following this defecation.

After this her bowel function was never normal throughout the summer and she had no natural movements, but became habituated to laxatives, mineral oil and enemata. It required many weeks of patient work with psychotherapeutic, mechano- and electrotherapeutic measures, together with dietetics and topical recto-sigmoidal treatment, before a good recovery of function was secured for her.

That cases of this kind do occur is quite well known, but too often forgotten. If patients of this type pass out of our hands and into the fold of one or another of the irregular cults, the fault is our very own. Our failure is twofold: Inability to make a correct diagnostic differentiation and a disinclination to adopt certain of the better mechano-therapeutic procedures which are effective in treatment. We have pinned our faith too strongly in the efficacy of internal chemical therapy alone. In constipation this is a fatal mistake. Long continued purgation inevitably spells constipation.

The laxative-enema habit must be broken as a starting point in the cure of constipation.

XI. Psychotherapy.—Certain patients with functional neurological states, especially when associated with congenital visceroptosis, have to be treated mentally as well as physically. S. Weir Mitchell or Du Bois' rest cure methods, combined with a management governing the principles of visceroptotic treatment must be selected properly. Psychotherapy here has a large field, and is an art with which we should all become familiar. These patients must essentially be "individualized," they cannot all be treated by the same standard, certainly not by any rule of thumb. Their entire environment must often be changed, their entire manner of living must sometimes be corrected. Hence the economic status of the patient often becomes the most important factor in the prognosis. The main need is to gradually lead these patients into being less introspective, to think out rather than to think in—make them realize that they have a real goal to shoot for, that if they want to regain their potential measure of health, they must stop comparing their symptoms in terms of yesterday, today and tomorrow, and be taught to look ahead steadfastly to see how they will be six months or a year from now, if they will play the game. Most of them have no hobby outside of themselves and must be given one. It is often a long, hard, uphill fight. They must be encouraged; but with the proper plan for each person really wonderful results may be accomplished.

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CHAPTER XXVI.

REVIEW OF A CLINICAL STUDY OF ONE HUNDRED CONSECUTIVE CASES OF GALL-TRACT DISEASE.

IN 1921, Dr. Bartle, Dr. Ellison and I undertook an intensive study of 100 consecutive cases of gall-tract disease observed in my private practice, starting from a period when the technic of this method had become perfected and carrying each case through a proper length of time so that it might be judged fairly on its own merits as an individual case.

The records of these patients were very carefully analyzed from 305 tabulated points of view, embracing etiology, symptomatology, physical examination of the entire gastro-intestinal tract and the common routine and various special methods of clinical examination. Thirty-one of them were studied by the roentgen ray and 35 of them by a careful review of the findings of previous abdominal laparotomies, 17 of which were operations or reoperations upon the biliary tract itself. These 17 laparotomies represented gall-tract operations done on 12 patients, 4 of whom had been operated upon twice and 1 patient three times, and all 12 of them were complaining bitterly of symptoms still referable to the upper right quadrant. Eight of these 100 cases we referred for operation or reoperation upon the gall-tract and in each one our preoperative diagnostic findings were confirmed in detail. Twenty-two of them had had their appendices previously removed. Finally, all were studied and restudied in the light of the direct evidence furnished by the cytology, chemistry and bacteriology of the bile and the manner of its delivery into the duodenum and by the reactions on the individual patient of this non-surgical method of biliary drainage. These various procedures provided the planks in the diagnostic platform. Ninety-four of these 100 cases were carried through a course of treatment by us and these cases particularly were critically analyzed and, where there was any reasonable doubt, the end result was entered against us as being unsuccessful rather than successful.

I propose in this and subsequent chapters to point out some of the lessons I have learned in regard to the importance of securing certain historical, physical, laboratory and technical data as a necessity in properly diagnosing and classifying cases of gall-tract

disease (with or without complications) as a first step in a decision for or against their management by surgical or non-surgical methods; to point out some of the lessons I have learned both for and against the therapeutic effectiveness of non-surgical biliary drainage; to point out some of my impressions both for and against the effectiveness of surgical procedures as exemplified in the cases studied, and to present some of my views as to future problems of biliary tract disease which must be worked out.

The first 3 case reports are of patients who have been observed over a period of four to six years. The next 8 case reports are of patients who have been observed and followed up over a period of two years or longer (and are selected from the group of 100 cases intensively studied). The remaining case reports are of patients all of whom have been observed, treated, or followed up carefully over a period of one year or longer, with the exception of Case XV and Case XLIII.

Also, I am including a series of 12 cases studied and treated by other physicians which speak for themselves. I am very much indebted to them for the privilege of using them in this publication.

In the series of 100 consecutive gall-tract cases intensively studied we found 27 per cent of clean-cut gall-bladder syndromes, 4 per cent of gall-stone syndromes, 22 per cent of a mixed syndrome (gall-tract, duodenum, appendix and colon), whereas 47 per cent presented only a vague atypical dyspepsia with or without biliousness. Eighty-eight per cent of these 47 cases showed an unsuspected masked infection of the duodeno-biliary zone, among whom 50 per cent showed streptococcic infection. Of these 100 cases 32 of them could have been readily diagnosed as gall-tract disease if studied only in the light of the history and physical examination, supplemented by roentgen-ray examination and by the usual gastro-intestinal methods; whereas 68 per cent of them would have failed of such diagnosis except by means of direct cytology, bacteriology and chemistry of the bile.

The first angle from which these cases were studied was from that of previous operation. It was found that 35 cases had been abdominally operated on prior to the present study. Of these 12 had undergone gall-bladder surgery, 9 of them accompanied by appendectomy and 13 had had appendectomies independent of this gall-bladder surgery. After reviewing the 12 postoperative cases of gall-bladder surgery to determine residual infection it was found that positive bacteriology could be demonstrated in the biliary tract in 62 per cent of the cases in which a cholecystectomy had been done and in 100 per cent of the cases in which cholecystostomy had been practised. In this small series, then, it would seem that cholecystectomy is the operation of choice, considering

only for a moment the question of residual infection. From the above it will be seen that surgery in the first place failed, in a too large percentage of cases, to free the biliary system of infection; and, in the second place, either failed to remove the primary focus causing multiple secondary foci or failed to recognize the early stages of biliary-tract infection and proceeded to remove the appendix alone.

The next point considered in our study was the question of attempting to find the *primary source of the infection* which had caused the gall-tract disease. I have felt for a long time that infection in the upper respiratory and digestive tracts is very frequently responsible for many of the acute or chronic conditions in the tract below. The six principal points of primary focal infection we found to be in the tonsils, gums or teeth, the posterior nares, sinuses or the bronchial tree. The five principal secondary foci are the stomach, the duodenum, the gall-bladder, the appendix and the recto-sigmoid colon. These may be involved singly, all together, or in series, but surgical or medical treatment directed to any one of them alone will not preclude a recurrence or later development of trouble at one of the other sites unless the primary source of the infection is eradicated. (See Report of Case XXVIII.)

Reviewing our operated group of patients from the standpoint of present or previous infection we found that in the 12 cases previously operated on we are able to demonstrate, by cultural methods, infection still present in the gall tract in 9 cases. Of the 12 cases we found that 10 of them showed in addition, pathogenic focal infection in the tonsils, teeth or sinuses. Of the 4 other cases whose biliary tract had been previously operated, 1 of them was an exploratory cholecystotomy alone and 3 were for the release of gall-bladder adhesions alone. Here, of course, there was no surgical attempt to remove infection and therefore these cases must be excluded from this angle of analysis.

Of 84 cases whose biliary tract had not been previously operated upon we could classify all of them as having various grades of cholecystitis; 24 of these 84 cases gave evidence by the tuning-fork test or by roentgen-ray examination of the presence of adhesions. Lastly, 14 cases could be classified as having gall stones in an active or quiescent stage.

Analyzing our 84 cases of non-operated gall-tract disease for residual focal infection we found 39 showed abscessed or suspiciously capped teeth; 29 cases had infected tonsils; 18 cases had pyorrhea; 17 cases had postnasal discharge, 3 of which were proved sinus infection; 6 cases had chronic bronchorrhea; and 4 cases had chronic otitis media. Several of these cases combined two or more points of infection.

Many of these patients showed associated functional, organic

or reflex disturbances of the gastro-intestinal tract. For instance, in 14 cases of proved or probable cholelithiasis 57 per cent showed the gastric acidity (by the fractional method) either markedly reduced or absent and 21 per cent showed hyperacidity; but in those cases in which gall stones could be reasonably excluded we found the gastric acidity reduced in only 34 per cent and absent in none, whereas 41 per cent in this group showed hyperacidity. In this respect our study confirms the findings of other investigators who have formulated a belief that a normal or increased acidity is a laboratory datum supporting a clinical assumption of cholecystitis as against cholelithiasis. This is in accord with the experimental evidence of Rost that the best normal physiological stimulus to the discharge of gall-bladder bile lies in a gastric chemistry rich in the proteoses, peptones and albumoses. Such conversion is only afforded by a normal or increased gastric juice. Therefore, in the subacid or anacid gastric states the gall-bladder bile is more liable to become static and crystals are thrown out of solution. This is the potential stone or precalculous state. If mucosal inflammation or infection be added, the formation of gall stones is accelerated. The table shown on page 496 contains an analysis of the associated symptoms and associated functional organic and reflex disturbances which occurred in this series of 100 consecutive cases.

Analyzing the possibility of multiple infection of the gastro-intestinal tract we found that 22 patients who had previously had their appendices removed (9 of them in conjunction with biliary tract surgery) still showed evidence of residual infection of the gall tract; that 21 cases gave clinical evidence of appendicitis with proved infection of the gall-bladder; that 3 cases showed a lesion of the gall-bladder associated with duodenal ulcer; and that 4 cases suggested associated lesions of the gall-bladder, the duodenum and the appendix. A good many of these cases, also, had inflammation of the recto-sigmoid, but were not specifically tabulated.

As previously mentioned in Chapter XIII, (see page 257), I have been impressed for several years with the diagnostic significance of *gross* biliary regurgitation, and believe it to be evidence of pathological physiology, with certain exceptions alluded to in Chapter XIII. In this study we found that of the cases with previous gall-bladder surgery 71 per cent showed *both* fasting and digesting biliary regurgitation as against 47 per cent of fasting and 23 per cent of digesting regurgitation in the non-operated cases. From this it would seem that operation on the gall-bladder very definitely disturbed the physiology of this segment of the gastro-intestinal tract. In addition it has been proved experimentally on animals, and by clinical experimental study of these postoperative gall-

ANALYSIS OF ASSOCIATED SYMPTOMS AND ASSOCIATED FUNCTIONAL ORGANIC DISTURBANCES OCCURRING IN 100 CONSECUTIVE CASES OF GALL-TRACT DISEASE.

	Cases.		Cases.
<i>Gastro-intestinal Symptomatology:</i>		<i>Pathological Conditions of the Colon:</i>	
Disturbed appetite	33	Colitis	25
Disturbed taste	39	Ptoxis	9
Bad breath	32	Atony	4
Nausea	54	Spasm	7
Heartburn	29	Redundancy	1
Dizziness	44	<i>Hemorrhoids</i>	13
Bloating	43	<i>Stools:</i>	
Belching	43	Deficient amounts	3
Flatulency	41	Incomplete defecation	4
Regurgitation	14	Bulky	2
Globus	1	Fermentative	7
Easy fatigue	63	Sour	5
Backache	36	Putrefactive	17
<i>Foods Disagree:</i>		Mucus coated	30
Fats	18	Mucus mixed	13
Proteids	24	Undigested food	7
Carbohydrates	14	Blood	9
Sweets	11	Pus	1
Acids	18	Float	11
<i>Pain:</i>		Sink	8
A. C.	3	<i>Associated Autotoxemia</i>	61
P. C.	27	<i>Associated Arthritis</i>	4
Nocturnal	9	<i>Gastric Motility:</i>	
Colic	12	Hypermotility	31
Dull ache	23	Hypomotility	15
Boring	12	Normal motility	41
Burning	12	Obstruction	
Other types	19	a. Pylorospasm	5
In attacks	13	b. Adhesions	14
Constant	9	<i>Types of Gastritis:</i>	
Food relief	18	Catarrhal	63
Chemical relief	9	Inflammatory	11
Distress	18	Infected	29
Gas pains	21	Occult blood	32
<i>Vomiting:</i>		<i>Röntgen-ray Corroboration:</i>	
Induced	15	Confirmed	23
Involuntary	16	Negative	12
Food	4		
Mucus	2		
Blood	0		
Bile	15		
Relief by	10		
<i>Headache:</i>		<i>Average Loss of Weight</i>	60 cases—13 lb.
Migraine	18		
Orbital	10		
Diffuse	21		
Other types	19		
<i>Sleep States:</i>		<i>Gross and Microscopical Study of Bile:</i>	
Insomnia	34	Grossly normal	5
Drowsiness	18	Grossly pathological	4
Unrefreshed in A.M.	13	Static	3
<i>Disturbances of the Nervous System:</i>		Atonic	1
Vagotonia	9	Inky black	1
Sympatheticotonia	8	Green brown	4
High-strung	51	Olive green	1
Phlegmatic	4	Cloudy	1
Neurotic	33	Infected	4
Neuritis	12	Turbidity	2
<i>Conditions of the Skin:</i>		Flocculations	6
Jaundice	15	Viscosity increased	6
Swarthiness	24	Microscopic mucus increased	4
Sallow	32	Exfoliation of epithelium	5
<i>Conditions of the Pancreas:</i>		Amorphous bile salts	2
Disturbed function	12	Rapid oxidation of pigments	2
Diabetes	2	Crystals	1
Normal	43	Sand	1
<i>Conditions of the Entero-colon:</i>		Fus	1
Constipation	53	Common duct open s. mag. sulph.	3
Atonic	34	"A" bile	6
Spastic	19	"B" bile	10
Diarrhea	19	"C" bile	2
Laxative or enema habit	33	No "B" bile	2
		Cholecystectomy	
		Cholelithiasis	
		Obstructed cystic ducts	
		Inflammatory	
		Adhesions	

bladder cases, that surgery in each instance has impaired the contrary innervation of the gall-bladder and Oddi's sphincter and has changed the normal physiologically intermittent discharge of bile into the duodenum into a pathologically continuous one, with, in many instances, harmful results, notably a severe and intractable diarrhea.

All of this series of patients had complaints referable to the gastro-intestinal or biliary tract systems, but, in addition to these localizing symptoms, a very large number (approximately 60 per cent) gave a history of symptoms suggesting focal infection or of autointoxication, the most prominent being easy fatigue, nausea, headache, dizziness and backache.

In 54 of these 100 cases the physical findings in the upper right quadrant were entirely negative; in 46 definite tenderness, muscle spasm or rigidity could be demonstrated.

There was no instance of palpable gall-bladder in this series of 100 consecutive cases. As stated in Chapter X, on physical diagnosis, I am convinced that the gall-bladder is a very difficult organ to actually palpate; that it is too often *thought* to be felt, whereas, at the operating table, the sense of palpable mass so felt is seen to be due to other structures, and the gall-bladder is found tucked up under the overhanging edge of the liver. On the other hand, in the occasional case the gall-bladder can be definitely palpated, although uncertainly defined as the gall-bladder, but such cases are unusual, and many mistakes have been made.

It was interesting to note that the *average* duration of ill health in these 100 patients was eight years. Most of these patients have gone through a period of variable but chronic disability.

Of this whole series positive bacteriology was demonstrated in 93 cases; the material was sterile in 4 cases and no culturable material was obtained in 3 cases. Of the 93 cases with positive bacteriology the streptococcic group was isolated in 50 per cent, staphylococci in 25 per cent, *B. coli* in 15 per cent, *B. subtilis* in 8 per cent, *B. pyocyaneus* in 1 per cent and *B. typhosus* in 1 per cent. These bacterial groupings represent percentages for this series of cases only. They would not average so for all groups studied. But as a general rule subsequent series have shown that the pyogenic cocci have the predominant percentages. Oftentimes the bacteriology shows a mixed or multiple bacterial flora.

I would allude to one other fact brought out in our study, and that is the importance of recognizing catarrhal inflammatory or infected states of the duodenum, independent of duodenal ulcer or adhesions. These states are much more commonly present than is usually realized and have great significance in the causation

of vague or atypical dyspepsias, and are conditions which often precede the later states of better developed pathology and a better understood symptom-complex. I found in this series of cases that 56 of them gave evidence of duodenitis, either simple catarrhal or with unusual exfoliation of duodenal epithelium, that 25 of these 56 cases gave evidence of bacterial infection of the duodenal mucosa and that 3 of them were infected with the *Giardia* (or *Lamblia*) intestinalis recoverable by tube in the living state. Obviously the diagnosis of these states of duodenitis can be made more accurately by the direct examination of the duodenal fluid than by any of the indirect methods.

To sum up the foregoing, the final diagnoses in these 100 cases, based on a careful analysis of the history, physical examination, various special examinations and the detailed information derived from a diagnostic non-surgical biliary drainage, were divided as follows: Gall-bladder syndromes, 27 per cent; gall-stone syndromes, 4 per cent; mixed syndrome (ulcer, appendix, gall-bladder), 22 per cent; and vague atypical dyspepsia (with or without biliousness), 47 per cent. There was "masked" infection, proved by culture, in 88 per cent of the cases. If, however, these cases had been studied only by the usual gastro-intestinal methods, supplemented by analysis of the history, physical examination and the roentgen ray, but without the added information derived from biliary drainage, only 32 per cent could have been diagnosed readily as gall-bladder cases. The remaining 68 per cent were impossible of such diagnosis except by means of direct cytology, bacteriology and chemistry of the bile.

To turn next to the question of *treatment*, 94 of these cases were treated by us. In all cases but 1 the chief therapeutic measure consisted in lavage and disinfection of the stomach followed by drainage of the biliary apparatus. Colonic irrigations were used only in exceptional cases where indicated. Recto-sigmoidal insufflation, after Soper's methods gave good results.

As the individual necessities of each case demanded, other indirect therapeutic measures were combined with this direct topical treatment. Medicine was given by oral, subcutaneous, percutaneous and intravenous routes. The only oral medicines used were digestive substitution products and hepatic secretagogues. Electricity, dietetics, glandular therapy, hygiene, psychotherapy, exercise or rest were prescribed in certain cases.

But the first bulwark of treatment was my insistence on topical treatment of the stomach, duodenum, biliary tract and colon. The second agent in which I placed most reliance was the autogenous vaccines. Especially were these useful when they gave rise to a

specific *focalizing* reaction reproducing one or more of the presenting symptoms, and those cases in which they occurred averaged better in their results. Among 58 cases receiving autogenous vaccines there were 17 who gave an unsolicited history of focalizing reactions simulating one or more of the chief complaints. Among these, gall-bladder pain or soreness was mentioned 13 times and migraine was mentioned 5 times. Pain in a tooth socket following a vaccine of streptococci obtained from the gall-bladder and from the apex of a tooth root in 1 case. Pain in the tonsillar fossæ following a vaccine of streptococci from gall-bladder and tonsil in 1 case; soreness in the appendiceal region was mentioned once; and increased joint involvement in a case presenting arthritis was mentioned once.

In summarizing the results of treatment by this method in this series of 94 patients I find that 73 of them showed complete arrest of symptoms (symptomatic recovery), 17 showed partial arrest of symptoms (improved) and that 4 of them were unimproved. But checking up from the objective standpoint, based upon a direct examination of the bile, we could demonstrate a complete return to normal findings in the bile in 47 cases, while 35 patients still showed abnormalities of the bile. On 12 patients there was insufficient data on this point to classify them, showing the need of correcting our errors of omission. As we were reviewing the results of treatment we noted the discrepancy in that 73 patients showed a complete symptomatic recovery, and yet in only 47 patients were we able to demonstrate a complete return to normal objective findings in the bile. This has indicated to me the inadequacy of considering simple arrest of symptoms as the criterion of a cure and emphasized the need of continuing the treatment faithfully until the pathological findings disappear; otherwise relapse is extremely likely to occur. (See Case X.) Again it was interesting to observe that as treatment was continued the complete improvement in findings ran more nearly parallel to the complete arrest of symptoms, and this, and this only, should be made the criterion of a real cure.

Eight of these patients were diagnosed and treated non-surgically for a short preparatory period and then referred for operation, and were then again postoperatively treated by us. All of these patients made complete recoveries except one. (See Report of Case XV.) Postoperative drainage, with protection of and treatment of the duodenum and intestinal tract, I believe to be a most important prophylactic measure to guard against relapse.

Finally it was instructive to me to learn that of the 17 cases who complained of focalizing vaccine reactions, 90 per cent had com-

plete relief of their symptoms as against 77 per cent for the entire series; and furthermore, 76 per cent showed complete return to normal findings against 50 per cent for the entire series. Hence my faith has grown in the efficiency of autogenous vaccines when properly selected by repeated culture checks, when properly prepared and properly administered, and particularly so when they give rise to focalizing reactions reproducing a presenting complaint.

In order to illustrate some of the lessons learned in the study of this and other series of patients, I will present some of the case reports with a few words of comment, in the succeeding chapters.

CHAPTER XXVII.

REPORTS OF CASES.

THE first case I am presenting was the very first patient of my series and illustrates what can be postoperatively accomplished by this method in treating acute choledochitis and cholangitis.

Report of Case I.—Long standing acute and chronic cholangitis with obstructive jaundice, following multiple operations on gall tract, cured by non-surgical biliary tract drainage and vaccines.

Miss A. I., aged seventeen years, was suffering with an infection of the common bile duct, with inflammatory swelling causing an obstruction of the duct. It had been essentially a chronic condition for two years, with intermittent acute exacerbations. This patient had had three major gall-bladder operations and two minor operations performed upon her in three years. The first one at the age of twelve years. In addition to this she had had six other admissions to the same hospital on both the surgical and medical services for non-operative measures for postsurgical sequelæ and had been treated by bed-rest, external applications, urotropin, the salicylates, morphine, codeine, sodium phosphate, nux vomica, cascara, calomel and other drugs, and was given various modifications of her diet, with at best only palliative effect.

At the end of this time she still had an infective choledochitis which was subject to acute remittent exacerbations of the most characteristic type. During the early spring of 1917, while in an acute attack, the surgeons in charge transferred her to me.

At that time she was definitely septic (of the chronic type), undernourished and intensely jaundiced. She had a leukocytosis of 17,000 to 26,000 with low polynuclear resistance. She was suffering intensely with acute paroxysmal upper abdominal pain and persistent nausea and vomiting. The muscles of her upper right quadrant were rigid and exquisitely sensitive to both light and deep palpation. In short, she presented the picture of a case that would be considered clearly surgical were it not for the fact that she already had had her gall-bladder drained for an acute empyema. Six months later her gall-bladder was removed and her common duct drained. One year subsequently the common duct

was again drained and several small stones were removed from the common duct, stones which had probably formed in the duct as a result of biliary stasis, associated with the persistent common duct infection and obstruction. The surgeons still had vivid recollections of the difficulties encountered in the last two operations of exposing the operative field on account of the dense mass of inflammatory adhesions.

This, then, was the first patient upon whom this direct non-surgical method of drainage was attempted. I am citing this case in some detail to direct attention (1) to the fact that it was certainly not the type of case in which one would expect much success from a new and untried method of treatment and (2) that it resulted in a most successful outcome.

This patient's obstructed common duct was unplugged by the local douching of the duodenum by magnesium sulphate and by the use of hot, bland inflammation-allaying solutions of boracic acid and Ringer's salt. In this case I believe the unplugging of the duct was more directly due to the effect of the latter two solutions, but I used the magnesium sulphate because I had just read Meltzer's article. On relieving the duct obstruction I recovered infected pathological bile containing pus cells, inflammatory debris, crystalline elements and bacteria. The *B. pyocyaneus* was isolated in pure culture from this bile. Incidentally it is of interest to note that this same organism was recovered from bile discharged from the abdominal sinus following her first operation five years earlier, and had doubtless persisted as the infecting agent, notwithstanding a thorough course of autogenous vaccination.

After the common bile duct had been unplugged it was kept open by continual duodenal-tube drainage for several days, with direct disinfection and cleansing of the duodenal zone with potassium permanganate and normal salt solution three or four times a day and duodenal feedings every fourth hour. After one week of this, biliary drainage for two hours, followed by duodenal disinfection, was practised every second day. By the third day following the inauguration of this direct method of treatment the critical picture of this patient had very materially improved; the paroxysmal pain subsided with the establishment of biliary drainage, the septic temperature dropped, the muscle rigidity relaxed, the intense jaundice lessened, the leukocytosis, which rose during the first three days from 17,000 to 26,000, gradually dropped. During the next four weeks there were several mild but never severe exacerbations, and from then onward her recovery was uninterrupted. By the ninth week the cultures from the bile which had continued to show the *B. pyocyaneus* were for the first time reported free from this organism. During this stage of her treatment and later she

was given a second long course of vaccination, which was carried on for two and a half months up to dosages of 3,000,000,000. During the next eighteen months she had two slight exacerbations, and on my return from France she reported herself at my clinic and was quite a changed girl; she had gained fifteen pounds in weight and had for the first time in my observation some natural color in her cheeks and a continued absence of jaundice. Besides, her acne, which was the worst I have ever seen, was very much improved. During this past year (1919) I have drained her common duct and irrigated her duodenum thirty-one times, partly because I have been using her case for some experimental work and partly because she has a fearful horror of a relapse, and because she states that she feels better after such treatments.

Her bile was cultured several times this year (1919) and was found free from *B. pyocyaneus*. But in February, 1920, I again had her bile cultured and to my intense disappointment it was reported to contain *B. pyocyaneus*. I had been congratulating myself on her apparent absolute cure. I was somewhat easier in mind, however, to find that the larger colony counts were coming from her liver bile, and I suspected that she had a low-grade chronic infection of the liver itself. Under these circumstances, perhaps an absolute cure was too much to ask of any method of treatment. Nevertheless her general restoration to such good health was in itself a most encouraging fact. A third set of vaccines were prepared and carried through and I continued to drain and disinfect her bile in the hope that final complete cure could be accomplished or at least might serve to ward off acute duct exacerbations.

Of course, we should remember that her future health may be menaced with biliary obstruction on account of the many adhesions, happily no longer acutely inflamed, which still serve to distort the roentgenographic outline of her duodenum, and it is for this reason, too, that I continued to treat her duodenum with Ringer's and other solutions. I felt that with this and in keeping her bile draining as freely as possible lay the best chances of final success.

This proved to be good judgment, for after five months of further biliary drainage and vaccine therapy the patient was apparently cured and was working hard in a department store every day, and cultures of her bile in October, 1920, no longer showed the presence of the *Bacillus pyocyaneus*.

It is perhaps also worth a word of record to state that this girl had, as a collateral finding, a severe eczema of the fingers and palms, which always became markedly worse during the exacerbation of her cholangitis, and never entirely cleared between times (see Fig. 165). This stubbornly resisted all manner of treatment from the Jefferson Hospital Dermatological Department. It would,

however, promptly improve each time that liver drainage was thoroughly established, and after three years of the type of management already detailed it has entirely disappeared (see Fig. 166).



FIG. 165.—Shows condition of hands in 1917 and 1918.



FIG. 166.—Shows improvement in condition of chronic eczema of hands (1922).

I append the complete hospital chronology of her case, with dates and diagnosis copied from the original records:

C. 1848. Oct. 5, 1912, to Oct. 31, 1912: Empyema of gall-bladder. Drainage.

C. 3291. Jan. 6, 1913, to Jan. 11, 1913: Removal of tonsils and adenoids.

D. 6353. May 13, 1914, to June 8, 1914; Cholecystectomy and choledochostomy.

E. 500. June 23, 1914, to July 16, 1914: Repair of sinus from gall-bladder.

E. 6395. April 16, 1915, to April 22, 1915: Hysteria and cholangitis.

E. 7308. June 30, 1915, to July 10, 1915: Cholelithiasis (duct) and choledochostomy.

F. 1454. Aug. 12, 1915, to Aug. 26, 1915: Perigastric adhesions.

F. 3208. Oct. 27, 1915, to Nov. 8, 1915: Abdominal adhesions.

F. 6778. April 15, 1916, to April 22, 1916: Abdominal adhesions.

G. 707. July 3, 1916, to July 15, 1916: Surgical neurasthenia.

G. 4879. Jan. 9, 1917, to Mar. 5, 1917: Chronic cholangitis.

Methodist Hospital, April 2, 1917, to June 20, 1917: Acute cholangitis and duodenitis.

Treatment continued since April 2, 1917, up to present writing by method outlined in this chapter.*

Report of Case II.—Illustrates preoperative diagnosis of cholecystitis and cholelithiasis, salvaging an infected gall-bladder and preventing the development of cholangitis by non-surgical drainage of the gall tract.

This case, an operative one of cholelithiasis and cholecystitis, accurately diagnosed by this method and confirmed by the roentgenologist, had a cholecystostomy performed and surgical drainage for eleven days. It was found six weeks later, by this method, that he still had an infective catarrhal cholecystitis in which the identical group of organisms as those originally isolated were still recoverable. He has since then been treated postoperatively by medical drainage, with encouraging success. This is the first motive for reporting this case, and the second is to show that the operator cannot by visible and tactile observation of living pathology always tell the amount of physiological function still left to a shrunken and apparently functionless gall-bladder unless it is completely fibrous. Some will say it would have been better surgical

* December, 1922, this young woman has remained perfectly well despite much hard work and has since married, and somewhat to my surprise went safely through a period of pregnancy, and still continues perfectly well six months after the birth of her baby. I feel that if she could safely pass this test of pregnancy she might be considered a genuine cure. She has had no drainages for over a year and still remains perfectly well. The last several cultures from the bile were sterile.

judgment to have resected this gall-bladder, on the grounds that its walls are probably the real source of the remaining infection. Perhaps so, but in that event this case might fall within my group of cholecystectomized postoperative cases who still continue to show evidences, clinical and direct, of infection. I think it is well to bear in mind that the surgical principle of drainage in any case of cholecystitis depends for success upon how *efficiently* bile drainage can be secured and upon how *long* it can be maintained, plus the contributing effects of bed-rest and modification of diet. Whether or not the infection is cured (in the true as well as in the surgical symptomatic sense) will depend directly upon three factors: first the virulence of the infection, second the resistance of the gall-bladder mucosa and wall (as well as those of the ducts) and its capacity to recover from the effects of the infection, measured in terms of the third factor, the efficiency and duration of the surgical drainage. After the surgical drainage tubes have been removed and the cholecystotomy wound has closed by adhesions or otherwise, *if the given gall-bladder has not been entirely relieved of its infection it is then left to Nature and to its own devices to do the rest.* The redevelopment of symptoms then becomes the apparent criterion of cure. It is here that the practical utility of this method for supplementary postoperative treatment becomes clearly apparent.

Protocol of Case II. Mr. J. H., a very robust man of forty-seven years, contracted influenza of the pandemic type, with bronchitis, in October, 1918. This was the only genuine infection of his entire life, although for twenty-five years he had suffered from chronic remittent attacks of migraine, which I believe may have been due to some degree of biliary stasis. His convalescence from the effects of the influenza was slow, and four months later he developed the first of five attacks of acute epigastric pain, colicky and cramp-like, followed by a dull aching and soreness, accompanied by vomiting, and during the last two attacks by jaundice of the mildest type. His stools were offensive and "gassy." During the four months' period of these attacks he had lost thirty-one pounds in weight. In none of the attacks was the pain ever referred to the back or to either shoulder, nor indeed even to the right hypochondrium.

Physical examination of his abdomen revealed *nothing* suggestive of gall-bladder, ulcer or appendix disease.

Examination of his stomach and duodenum revealed an infective type of anacid gastritis and duodenitis, and direct examination of his biliary system showed a pathological "A" and "B" bile, the latter containing the greater abundance of mucopurulent elements, a swarming mixed bacterial flora and such an abundance of bile crystals as to impart a distinctly "gritty" feel to his bile. Cultures from "A" and "B" bile recovered the following organisms: *B. coli*,

pneumococcus capsulatus, Streptococcus viridans and Micrococcus tetragenus. The recovery of three of this group of organisms strongly suggests the relationship of his gall-bladder infection to the preceding influenza with bronchitis.

A diagnosis of infective cholecystitis and choledochitis was made, with a suggested possibility of cholelithiasis, the latter being confirmed by the roentgenographic study of Dr. W. F. Manges. On account of the calculus state he was referred for operation. Sequence of events in his case:

Operation, October 16, 1919 (Dr. J. D. Elliott). Stomach and duodenum explored and declared surgically negative. No adhesions. Gall-bladder exposed and found shrunken and contracted, with thickened wall but no adhesions, and apparently it did not contain stones. However, on opening the gall-bladder it was found filled with a thickened greenish-black bile, similar to that of "B" bile, and between fifty and sixty small stones were scooped out, ranging between the smallest granules to large match-head size. (Fig.

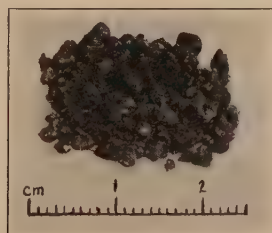


FIG. 167.—Small gall-stones; some small enough to be recovered by duodenal tube.

167). The gall-bladder was not removed (probably wisely) and rubber-tube drainage was sewed in with chromic gut. Surgical drainage was carried out for a total of eleven days. Postoperative recovery was uneventful.

Now, aside from the surgical removal of his gall-stones, was this man cured of his gall-tract infection?

November 27, 1919. Mr. J. H. returned to me for reëxamination. Direct examination of his biliary system revealed "A" and "B" biles to be definitely pathological, the latter containing a swarming bacterial flora, very many mucopurulent flakes which ran over 100 pus cells to the field, inflammatory débris, but a less evident deposition of bile crystals. Cultures from that bile recovered the identical group of four organisms as isolated before operation. Clearly then this patient had not been cured of his cholecystodochitis by the eleven days of surgical drainage.

Since November 27, 1919, he has had his biliary system physiologically drained by this method once a week, with gastric and

duodenal disinfection, followed by transduodenal lavage with Ringer's salt or Jutte's solution, with steady improvement in the cytological findings, the mucopurulent shreds particularly have gradually decreased and the bacterial flora is less evident. He was given injections of an autogeneous vaccine and took hydrochloric acid and pepsin and followed an appropriate diet.

It was interesting to learn that this man's apparently shrunken and thickened gall-bladder wall is still capable of delivering bile under physiological stimulation in amounts varying from two to four ounces. Certainly, the function of this man's gall-bladder was *not destroyed and gave promise of eventual restoration*.

To have seen this man, entirely symptom-free, with his good color and having regained his weight, no one would dream that he still had lurking in his gall tract a dangerous microbic infection capable of lighting up and producing further mischief unless carefully watched and controlled by this very simple and practical method. (12)*

Report of Case III.—Illustrates methods used in the successful management of a complicated chronic case of long standing, featured by chronic hepatic intestinal toxemia, biliary migraine, disseminated infection complicating visceroptosis.

This case is reported because it illustrates what is possible of accomplishment in the treatment of biliary stasis, with low-grade infection of the gall-bladder and ducts, resulting in the severest type of migraine and evidence of early toxic arthritis. This may be called a "masked" gall-tract disease, at no time giving rise to symptoms severe enough to warrant surgical consultation. Perhaps persistence in this method of treatment may result in true cures in many of these cases, especially if caught early. Certainly the relief of symptoms after so many other measures have been unsuccessfully tried, entitles us to place high hopes on this method of physiological biliary drainage combined with transduodenal lavage and the use of specially selected contributing measures to meet various angles of disorders and diseases, only brought to light by a searching diagnostic review of the various systems of the body. This case is also worthy of report to illustrate how the primary focus

* December, 1921. Since February, 1920, this patient has been treated at gradually lengthening intervals, and for the past three months has had a biliary drainage only once a month. Vaccine therapy has been continued. When seen, on September 18, 1920, his biliary examination was quite normal. He has remained perfectly well and, in his own words, "never felt better in my life."

Final follow-up to January, 1923. This patient still continues to remain perfectly well, although he has had no drainage for over a year. At that time absolutely normal objective findings were secured.

of infection may give rise to successive foci in the gastro-intestinal tract even though the primary focus itself has become quiescent or has disappeared; it also illustrates the advance of gastro-intestinal disease from one zone to another, with a corresponding transition in symptoms. Finally, this case illustrates the ease with which this method of *treatment* may be carried out, after a little preliminary instruction even in the hands of relatively unskilled doctors or attendants.

Mrs. "K." was referred to me on August 27, 1919. She was aged forty-nine years and married, with one daughter aged sixteen years, her only conception.

Her chief complaints were many, but in the order of importance to the patient were:

1. Headaches of great severity and frequent occurrence in cycles of variable duration.

2. Gas on the stomach, with nocturnal and diurnal cardiac palpitation.

3. Dizziness and light-headedness and easy fatigue.

4. General abdominal bloating, with wandering pinching and cutting, general abdominal pains, with sensations of "raw spots" in the abdomen.

5. Intestinal gas of offensive odor.

6. Obstinate constipation, if not daily prevented by laxatives, resulting in increasing laxative habit for fifteen years. Stools contain much mucus in the form of coarse shreds, casts and ropes, and stools are described to conform to type of spastic constipation.

7. Progressive loss of weight and strength.

Past Medical History: Measles, parotitis and pertussis in childhood, and since then has never been sick in bed except with "sick headaches," which have occurred with increasing severity and frequency.

Present Illness: She states that she has had "bilious headaches" ever since she can remember, many of them accompanied by sick stomach and occasional vomiting. For twenty-five years her headaches were associated with nausea and sour, gassy stomach, but about ten years ago the gastric symptoms disappeared and were replaced by lower abdominal bloating, cutting and pinching abdominal pains and increasing mucus in the stools, with increasing constipation punctuated by intermittent diarrheal periods. The headaches increased in severity, frequency and duration, and are described as follows: They begin as left orbital and pass to the left temporal region—less frequently beginning in the right orbital region. They are very severe, usually putting her to bed; formerly lasting for eight to ten hours, for several months past they have lasted for two to four days. After the acute headache has stopped

she will try to eat a little, and about two to four hours later gets a diffuse headache, with especially a sense of intense pressure on top of the head. She finds it is always worse after the head is exposed to cold or drafts, and so wraps her head in a hot woolen cloth, with some relief. Recently she has noticed that the bilious, sour stomach is not so noticeable a prodromal symptom, and has been replaced by pain in the arch of the left foot and under the toes, which become stiff and swollen and burn. The following day she wakes up with a sick headache. She says if she were not very careful with her diet she would have headache all the time; that she has not eaten any fried foods in nine years, because these always aggravate the headaches. She eats boiled meat (beef, lamb, chicken) with agreement, but thinks vegetables cause bloating and intestinal gas and increase the headaches. Tea and sweets also disagree. She states that for twelve to fifteen years she has been troubled with her teeth, with cavities and advancing pyorrhea, and that three months ago all of her teeth were extracted. She fights constipation all the time, because her headaches have been less when her bowels move freely, and she has occasional spells of diarrhea, with much mucus. She uses daily three to eight "pink laxative" pills and Pluto water. Her skin became sallow several years ago, but has become progressively browner and more bronzed. She has noticed progressive loss of strength and weight during the past eleven years, the latter totaling 19 pounds, from 110 to 91. She has also noticed increasing depression and melancholia, and has been told that her case was "incurable." She has worn eye glasses for two years without any improvement in the headaches.

Physical Examination: She presented the typical appearance of one suffering from a chronic intoxication or infection. Asthenic type. Thin, anemic, tired-looking, with dark circles under eyes and sallow brown complexion, with dry skin and thin, gray, dry, lusterless hair. Eyes: negative except for dilated pupils.

Nose, tonsils and glands are negative.

Tongue coated; gums clean and well healed and wears well-fitting double plates.

Dermatographia well marked. No typical Addisonian findings.

Thorax long and emaciated.

Lungs: Fibroid apices.

Heart: Normal in S. and P., no M. Tone fair, rate 80 to 90.

Pulses equal. Blood-pressure 140-90. Very little sclerotic change in radials, brachials or temporals.

Abdomen: That of the visceroptotic—space encroached upon by long thorax, flat epigastrium and bulging umbilical and iliac zones—with visible peristalsis.

Costal angle medium narrow. Visceroptotic index, 0.83,

Abdominal aorta and right iliac artery uncovered, forcibly pulsating and tender. Tender also over solar plexus and over sigmoid, the latter being distinctly spastic and contracted.

Stomach in normal position but dilated.

Transverse colon ptotic. Right kidney floating.

Rectal examination reveals only internal hemorrhoids and external tags.

Spinal Examination: Slight scoliosis to left and soreness over the left transverse processes of the fourth to eighth dorsal vertebræ, and pain on pressure over the left transverse process of the eleventh dorsal vertebra.

Extremities and joints negative.

Deep reflexes normal.

Special and Technical Examinations: Urinalyses show only faint traces of albumin, intermittent presence of indican and hyalin casts. No fixation of specific gravity; tendency to polyuria. No retention of chlorides or urea nitrogen.

Functional phenolsulphonephthalein test: 1st hour, 370 cc, 50 per cent elimination; 2d hour, 160 cc, 20 per cent elimination; 3d hour, 120 cc, trace; total, 650 cc, 70 per cent plus elimination.

Blood. Moderate secondary anemia. White blood cells, 6300. Wassermann negative.

Gastro-intestinal Examination: Summary of fractional gastric study:

Fasting stomach: No food rests; much mucus; 5 cc F.HCl = 0; Total acid = 20. Blood, 0.

Microorganisms plus, including *Leptothrix buccalis*. Few polys.

Fractional curve of anacidity, hypermotility and biliary regurgitation.

Mucus greatly increased. Enzymes and proenzymes present but deficient.

Wolff-Junghan's test for soluble albumin 1 to 40. Increased intestinal motility. Ten grains of carmine powder given in a mixed meal appeared in stool in ten hours and was completely defecated at fifteen hours.

Duodeno-biliary examination:

After mouth and stomach cleansing and disinfection, duodenal tube entered duodenal biliary zone in sixteen minutes. Much duodenal mucus; sphincter of bile duct open and bile discharging. Flow accelerated by douching with magnesium sulphate.

"A" bile diluted by small amount of magnesium sulphate. 36 cc, light yellow, clear, syrupy.

"B" bile 51 cc dark greenish-black, molasses-like static bile with few mucopurulent floccules containing bile-stained columnar epithelium and leukocytes. Bacteria very evident.

Cultures from "B" bile: *B. pyocyaneus* and *Staphylococcus aureus*.

"C" bile light lemon yellow, thinly mucoid.

Examination of bile for pancreatic activity:

Trypsin: 1 cc of bile digests 10 cc of 0.1 per cent solution of casein in fifteen minutes.

Amylopsin: 1 cc of bile digests 5 cc of 1 per cent solution of starch in thirty minutes.

Stool Examinations: Spastic scybalous and small calibered sausage masses pointed at one end, superficially covered with shaggy, stringy mucus, rather pale yellow color. No gross indigestion of food. Occult blood positive.

Microscopically: A few muscle fibers, with preserved connective tissue, but partially digested. No starch remnants. No neutral fat but many fatty acid crystals (split fats); slightly increased cellulose.

Bacterial smears chiefly Gram-negative.

Diagnostic Deductions: In somewhat their order of importance:

General Diagnosis:

A. Major.

1. Chronic toxemia.

(a) Bacterial, with first focus of infection probably in teeth and gums (oral sepsis, now clean) passed to secondary foci in stomach, gall-bladder and colon.

(b) Metabolic, from static biliary source; from intestinal and renal sources and from static vascular (splanchnic) circulation due to visceroptosis.

2. Visceroptosis.

3. Chronic cholecystitis (masked), of low grade of infective virulency and preceded by chronic biliary stasis.

4. Chronic mucous colitis, with spastic constipation, probably first due to vagotonia and now continued, owing to erosive areas in colon.

B. Minor.

1. Chronic interstitial nephritis—probably early and secondary.

2. Fibroid lungs—probably quiescent or healed tuberculosis.

3. Sympatheticotonia (dilated pupils, relatively high pressure, subsecretory states—dermatographia).

4. Low grade early toxic arthritis.

5. Chronic atrophic gastritis.

Conduct of treatment decided upon:

I. *General.* To improve toxemia by appropriate treatment of the

(a) Visceroptosis (bed-rest, elevation of foot of bed, properly selected and arranged diet to improve assimilation and weight-building, proper abdominal support).

(b) Mucous colitis (breaking chronic laxative habit and substituting "senna-fruit paste," (see page 463) which is gradually withdrawn; proper dietary; associated effect of transduodenal lavage and other topical treatment).

II. Direct treatment by physiological-biliary drainage to arrest the progress of the cholecystitis and to attack the biliary stasis, considered to be the dominant causative factor of the migraine attacks (her most bitter chief complaint).

Method of Direct Treatment. Bi-weekly physiological-biliary-drainage, preceded by mouth disinfection, gastric lavage and disinfection, with silvol.

After physiological-biliary drainage and disinfection of duodenobiliary zone a transduodenal lavage was given of Ringer's salt, with 1 per cent sodium sulphate, in amounts of 250 to 350 cc. Given very slowly by drip method.

This treatment was carried out for three or four weeks at the Methodist Hospital for the purpose of training the patient and nurse and to teach the principles of a visceroptotic rest cure.

Treatment then continued by nurse at patient's home, bi-weekly for five weeks more, then once a week.

Visceroptotic rest cure treatment continued.

High caloric diet, suited to her achylia, and digestion aided by substitution gastric digestants. Benzyl-benzoate was used for its effect on the spastic colitis. No laxative was given except a 2 per cent senna paste, later decreased to 0.5 per cent.

The dark green-black static bile of molasses consistency was evident in each of the first three or four treatments in amounts of 75 to 120 cc, but thereafter gradually lightened in color to a golden-yellow, the inflammatory cytological elements lessened and the bacterial content decreased and all biles showed improvement in gross appearance. An autogenous vaccine of *B. pyocyaneus* and *Staphylococcus aureus* was prepared and given twice weekly.

Progress of Case. Notes of December 17, 1919. Patient shows a wonderful improvement. Looks so much better; color less sallow—brown; skin less parchment-like; dark circles under eyes are practically gone. She has much more endurance, energy and strength. She has gained 15 pounds in three and a half months, from 91 to 106 pounds (kimona weight). Her bowels are moving once or twice daily, with one-half teaspoonful of 0.5 per cent senna-fruit paste at bedtime. The mucus has disappeared nearly completely from the stools. The wandering abdominal pains are no longer felt and the spastic type of bowel movement is no longer seen.

Best of all, from her standpoint, the headaches have from the onset of treatment been much less frequent, never severe, and for the past ten weeks she has had *none*,

How long her improvement will last or what will be the future development when treatment is finally interrupted I do not pretend to even guess.* I am not inclined to believe in so-called "cures" of essentially chronic disease. Arrest of symptoms, quiescence of lesions, yes; but "cures" in the true sense I do not believe in.

* This patient returned to her home and continued self-treatment by this method three or four times a month. She was last examined in the office in July, 1922, and appeared to be remarkably improved. The appearance of the bile was nearly normal, the swarthiness of her complexion had disappeared and her endurance was much greater. She had maintained her gain of 15 pounds in weight, she had had no severe headaches and her bowels are moving twice daily, with no other laxative than senna-fruit paste once a day.

CHAPTER XXVIII.

REPORTS OF CASES.—(CONTINUED.)

Report of Case IV.—Illustrates a type of early gall-tract catarrh and infection, complicating a disseminated infection of the gastrointestinal tract, which will respond favorably to non-surgical biliary drainage and vaccines after the causative extragastric foci have been removed.

(Case No. 987).—Mr. W., aged thirty-seven years, was referred to me on June 9, 1920. With the exception of an attack of slight jaundice in 1900 and a tendency to recurrent tonsillitis prior to 1903, at which time his tonsils had been presumably removed by a tonsillotomy operation, this patient had enjoyed robust health until he suffered a severe attack of pandemic influenza in October, 1918. With this he was for five weeks very sick in bed. It was complicated by bronchopneumonia and cardiac insufficiency, which prolonged a slow convalescence through several months. In April, 1919, he had an attack of what was called "trench mouth," with spongy, bleeding gums, which lasted for one month. In March, 1920, he was told he had "acidosis," and had been given large doses of milk of magnesia, which he has continued to take for the past three months, with the result that his bowel movements have become very loose, contain slimy and shreddy mucus and are rather foul-smelling. In one year he had decreased in weight from 182 to 155 pounds, although he stands six feet two. His chief complaints were progressive weakness, a sense of nervous gripping in the right epigastrium, followed by a sense of "empty pain" about one hour after meals, sometimes wearing off spontaneously, but always made temporarily better by eating. He also complains of rectal tenesmus.

Physical examination disclosed numerous foci of infection as follows: The *tonsils* were inflamed and boggy, enlarged and cryptic, and pus could be readily expressed from both of them, smears from which recovered streptococci in abundance. Roentgen ray of his *teeth* showed three well-defined abscesses. His *stomach* examination disclosed a definite infective catarrhal gastritis, with a high normal secretion and motility retarded intermittently by pylorospasm. His *duodenal cytology* showed a moderate catarrhal and exfoliative

duodenitis, and drainage of his *gall tract* demonstrated a well-marked and exfoliative cholecystitis and choledochitis with masked infection. *Cultures* from his "B" bile recovered a hemolytic streptococcus. His gall-bladder discharge ranged between 90 and 150 cc of static, green-black, slightly turbid bile of increased viscosity, and contained large numbers of mucopus flocculations. The microscopy of this showed much bile-stained columnar epithelial exfoliation, numerous pus cells, a large amount of precipitated bile salts and cholesterin crystals and numerous colonies of bile-stained cocci. As a result of this inflammatory state we found the common duct uniformly open in the fasting state without the use of magnesium sulphate. This I believe to be evidence of disturbed physiology which may be functional or associated as a reflex to pylorospasm, appendicitis and colitis, but which occurs much more commonly when there is a duodenitis or inflammation of the gall tract.

He presented historically the symptom-complex of duodenal ulcer, but which, in the absence of specific laboratory and roentgen-ray confirmation, I have come to recognize as a mixed syndrome, which may be functional pylorospasm, duodenitis, duodenal ulcer, cholecystitis, appendicitis and, rarely, ileocolitis, with special involvement of the rectosigmoid. He gave, however, no direct clinical, historical or physical findings that suggested gall-tract disease other than his attack of catarrhal jaundice twenty years previously. In addition, on examination I found a suspicious tenderness in the region of his appendix or cecum and an inflamed or spastic sigmoid. His blood showed a moderate secondary anemia with a negative Wassermann. His pulmonary, cardiac, renal and endocrine systems were relatively normal, but his nervous system was distinctly under tension, with a disturbed sleep picture of involuntary twitchings and a tendency to fantastic nightmares.

Here, then, was the picture of disseminated infection of the gastrointestinal tract, most probably emanating from the tonsils and contributed to by the infection at his tooth roots, and, with his general resistance materially broken down by the severe type of influenza, with its complications, through which he had passed, we find his mucosal surfaces a fertile ground for the transplantation of the streptococcus.

As a first step in his treatment I had his tonsils removed and cultured and a vaccine was made from the hemolytic streptococci recovered from them, mixed in equal amount with the same organism grown from his gall-bladder bile. The similarity of growth of these streptococci in various media suggested them to be of the same strain. Two of the three teeth showing apical abscesses were extracted in Boston (no culture being made, unfortunately) and the sockets treated. He was then given a duodeno-biliary drainage

with a duodenal enema twice a week, together with a vaccine injection and iron citrate, sodium cacodylate and sodium glycerophosphate subcutaneously. His symptomatic response was prompt and his recovery was progressive. After 17 such treatments he had gained 14 pounds (from 155 to 169) and was called back to Boston by business and was referred into the care of Dr. Franklin W. White, who continued his treatment at greatly increased intervals. During my observation of him his abnormal findings in the duodenum and gall tract had progressively improved, and on December 31, 1920, Dr. White writes: "The last bile drainage was done on December 22. The bile was a very clear green-yellow with nothing abnormal in the sediment. He is feeling entirely well and has gained steadily from 169 to 186 pounds, which he weighs today." *Follow-up:* Ten months later this patient still remains perfectly well.

Comment. This case represents a severe type of disseminated infection of the gastro-intestinal canal, with a masked lesion in the gall-bladder in the early stage, in which the symptoms are more suggestive of a pyloro-duodenal ulceration rather than involvement in the gall tract. It illustrates the importance of early diagnosis by the differential methods I have advocated. Later on the symptomatic picture will change and may call attention to the gall-bladder, but often by that time the pathology is extensive. This case finally teaches us that we may achieve excellent results and may prevent the necessity for later surgery in many cases; but we must start our treatment by removing all recognizable foci higher up in the tract and then energetically treat the condition itself by topical and direct methods. I have 18 other cases in this series of 100 studied and treated who may be classed in this group.

Reports of Cases V and VI.—Illustrate types of biliary migraine associated with atonic gall-bladders and with toxic factors in liver and intestines, which respond favorably to non-surgical drainage of the gall tract. Drainage, together with associated general management, must be kept up for long periods in stubborn cases if final success is to be secured. Other causes of migraine must first be eliminated.

CASE V (Case No. 1004).—Miss E. B., aged forty-three years, referred to me on July 11, 1920, had for ten years been suffering from severe prostrating migraine attacks which occurred in somewhat definite cycles every ten days to two weeks. She had tried out a great many remedies for relief of these sick headaches, with apparently no improvement.

She gave a history of absolutely no preceding infections in her past life except a stuffiness and catarrh in the left Eustachian tube,

which has been under constant treatment by a most excellent specialist, with distinct improvement, and yet showed a tendency toward relapse.

On very careful *physical examination* she had absolutely normal findings in her eyes, nasopharynx, bronchial tree, lungs, heart, kidneys and pelvic organs. Her *gastro-intestinal* studies were likewise negative except for the particular findings in the gall-bladder and duodenum, which will be mentioned later. She had had constant and progressively more obstinate constipation for many years and represented a typical constipation-laxative habit vicious circle.

She states that the migraine attacks come almost without warning, with no causative factor to which she can ascribe them. They last from two to four days of intense prostrating "sick" attacks, and when at the worst are always accompanied by dry retching and terminal vomiting of bile, which usually brings the attack to a close. She has temporary relief in the use of cholagogues, especially calomel and salts. She describes the attacks as beginning with a "thick" feeling in the head, followed by pain which is first felt over the right eye and radiates down the temple to the right mastoid region. Less frequently the pain is felt, also, over the left orbital region, with the same distribution. This may be due to the influence of Arnold's auricular branch of the pneumogastric nerve. The abdominal physical findings were entirely negative, although special attention was paid to the gall-bladder region.

No direct diagnostic evidence could then be furnished from her examinations, which pointed toward the gall-bladder, except the historical data of recurring bilious attacks associated with migraine and the further fact that she had been noticing a progressive brownish pigmentation of her skin, which had been definitely deepening during recent years.

Her *duodeno-biliary drainage* examinations supplied the necessary diagnostic data, for I found the gall-bladder bile to be static, inky-black, with increased viscosity and mucosity, and delivered intermittently in the manner of the atonic flow previously described, and infected with a *Streptococcus viridans* and *Bacillus coli*. In this "B" bile was found a large amount of flocculent sediment, the cytology of which showed marked exfoliation of tall columnar, bile-stained gall-bladder epithelium, with much amorphous bile-salts, cholesterin crystals, pus cells, strands of mucus and bile-stained bacteria in the colony formation representative of true infection.

Her treatment consisted of duodeno-biliary drainage, followed by duodenal enema twice a week for two weeks, then once a week for a month, then twice a month for a period of three months. Auto-genous vaccines were given every five to seven days and caused a

focalizing reaction reproducing the migraine. With the exception of pancrobin nothing else was used for her constipation.

The result of this treatment showed steady progressive improvement both in symptoms and in the objective findings in the bile. The migraine attacks became of lighter and lighter severity and of decreasing frequency, and she noted a general systemic improvement in her increased alertness, power of concentration, better sleep states, increased amount of vigor, and especially notable to her was the progressive absence of her sense of daytime drowsiness and the rather remarkable clearing of the brownish pigmentation of her skin and improvement in her complexion.

She has recently been seen and reexamined and has had no headache for a little over four months, and says she feels splendidly well. She had had no bilious attacks; her skin was clear and showed practically none of the earlier pigmentation; her bowels were moving once daily and naturally, without any laxation; and her biliary drainage showed an absence of all the direct evidence recorded above upon which her diagnosis had been based.

Comment. This case illustrates biliary migraine in its purest form and the hope of relief which can be offered by this method of treatment. This case also illustrates how conditions of this sort, if unrecognized and untreated, inevitably lead later into the final states of gall-bladder pathology and calculus formation in the presence of a "masked" or unsuspected infection, especially when associated with catarrhal exfoliation. Even at this stage it could be repeatedly demonstrated that she was in the precalculus formation period by the finding of cholesterol crystals thrown out by a bile incapable of holding them in solution. I had in this series 19 cases which can be placed in this group. Only 1 other of these was in the pure form of biliary migraine represented in the case reported above. Seventeen had definite migraine sick headaches, with usually terminal biliary vomiting, but showed, in addition, different disturbances of function or pathological states of the biliary or gastrointestinal tract. Of these, as a result of treatment, 13 showed complete arrest of the migraine, 3 partial arrest, that is, a lessening in the intensity and frequency of the attack, and 1 case made absolutely no improvement in this particular, although improved otherwise. In addition, 9 other patients exhibited severe headaches but not of the migraine cyclic type, and all 9 of them showed complete arrest of this complaint as a result of treatment. It has appeared to me that this group associated with headaches, biliousness and "masked" infection are in *earlier* stages of gall-tract disease and often amenable to this form of treatment. Conversely I have frequently noted that in the group whose diagnoses of biliary disease can be made quite clearly on analysis of history and physical

findings *alone* the patient gave us histories of having these severe migraine or migrainoid headaches one to ten years previously, but are no longer complaining of them in their present account of their illness. Apparently, then, when they have passed through this phase spontaneously they are in a later stage of gall-tract pathology. Many of these patients show a tendency to relapse and must keep up treatment for a long time in order to secure the best results.

CASE VI (Case No. 1129).—Miss E. M. R., school teacher, aged forty-two years, referred to me on March 3, 1921.

Chief Complaint. Nausea, dizziness, bad color and attacks of brief unconsciousness.

Past History. No serious illness except typhoid fever complicated with pneumonia in 1894, with slow convalescence extending over four months. Since then never really ill, but with insidious onset about five years ago she has gradually developed nausea, dizziness, increasing swarthy, headaches, right shoulder-blade pain; and when attacks are very bad she has severe occipital pressure, dancing specks before eyes, "everything goes black," and she falls to the floor or street, momentarily unconscious. These attacks have been somewhat relieved by the use of liver pills. While normally of a happy, optimistic nature, she has become depressed, melancholic and "wants to cry." She has been a frequent meal skipper, often doing without lunches, and on some days two meals have been missed. Marked loss of power of concentration, upon which she prided herself, to an extent now seriously interfering with her efficiency as a teacher. Loss of 11 pounds weight in six months. Sleeps soundly, but utterly unrefreshed in morning, and recently troubled with bad dreams. Wakes nauseated.

Physical Examination. General appearance tired and toxic. Swarthy, pigmented skin of about the color of an octoroon, with very dark pigmented rings under eyes. Left tonsil infected, pyorrhea, and one badly infected piece of bridge work. Chronic nasal catarrh. Scleræ and palate definitely jaundiced.

Abdomen. Moderate tenderness in upper right quadrant and doubtful tenderness over McBurney's point.

Spine. Sense of soreness at eleventh thoracic vertebra, left transverse process. Hemorrhoids.

Laboratory Examinations: Blood. Hemoglobin, 82 per cent; white blood cells, 7520; polymorphonuclears, 66 per cent; transitionals, 3 per cent; large mononuclears, 2 per cent; lymphocytes, 29 per cent.

Gastric Analysis. Slow hormonal response up to forty-five minutes, when free HCl is 10, total acidity, 20, but rapidly rises to

high terminal point at one hundred and twenty minutes of free HCl 45, total acidity 100. Typical extragastric curve with delayed digestion. Fasting biliary regurgitation.

Urinalyses. Negative, with the exception of indicanuria.

Stools. Suggesting ileocolitis.

Biliary-tract Drainage. Normal duodenal entrance time. Oddi's sphincter relaxed. Moderate duodenitis. Choledochitis. Atony of gall-bladder with "B" fraction very static, inky-black, *intermittently* discharged in very small amounts. Early cultures sterile, although streptococcus definitely found in fresh stained spreads. On third and fifth cultures a streptococcus (untyped) was grown out.

Treatment. Care of tonsils, gums, teeth. Vaccine therapy. Pancrobilin. Biliary-tract drainage once a week for ten drainages. Very marked improvement. Patient sent home to continue home drainage once every week or two weeks.

Progress of Case. February 10, 1923. Just one year since last visit. Has gained 15 pounds. Looks very well, skin very much less swarthy and complexion good. Home drainages once every two weeks, and finds that if she extends the time very much beyond this she becomes "top-heavy, dizzy, nauseated and color becomes bad." Bile always darker when condition is worse, but never finds the "B" fraction so inky-black as originally, and drainage is much more free. Right shoulder-blade pain gone. Has not lost any time from her teaching work in a year and a half, and has had no need of any medical attention. What pleases her most is her returned power of concentration, which was formerly interfering with her efficiency as a teacher. No longer depressed. Bowel function normal.

Drainage findings today grossly normal, except for moderately static bile, and a cultural report by Dr. Kolmer of *Staphylococcus aureus* and non-hemolytic streptococcus. A further vaccine will be prepared and used.

Comment. After nearly two years the best that can be said of this case as regards an end-result is that this patient is symptomatically very greatly improved. A means has been given her by which her disability can be controlled. It may have to be kept up for an indefinite period, perhaps years. Is it worth it? This case now is in much better condition and an operative procedure could most probably be safely carried through. This was suggested to the patient and the lady questioned me as to what would be done. I replied, "Your gall-bladder can be removed if there is found justification for it at the operating table, and your common or hepatic ducts can be drained." "Will this get me permanently out of my difficulties?" As to this who can say? We have seen a large percentage of satisfactory recoveries and yet too many similar cases

still not only fail of recovery, but are made definitely worse and require serial surgery. If this patient can continue to live in an improved state of health and with continued reasonable comfort and efficiency by utilizing this measure, it does seem justifiable to continue on with such a plan of management until it ceases to be effective, even at the risk of developing later pathology. Perhaps this is not so justifiable at this patient's age as it would be if she were ten or twenty years older. (Contrast with Case II A.)

Report of Case VII.—Illustrates the usefulness, and possible life-saving effectiveness, of non-surgical biliary drainage in acute cholecystitis complicating typhoid fever.

Dr. H. F. E., aged thirty-nine years, to whom I am indebted for giving me the following account of his personal experience with non-surgical biliary drainage in the treatment of acute cholecystitis complicating typhoid fever.

He was taken sick in April, 1920, with walking typhoid, during which period blood cultures were negative. He collapsed after the third week and was taken to a hospital, where he ran a typhoid course for ten weeks. He suffered a relapse after the fourth week. For three or four days previous to this relapse he had had considerable gas after meals and abdominal distention which previously had been relieved by enema. Enemas no longer removed the gas and suddenly one evening the patient was taken with acute distention in the region of the gall-bladder, at the left edge of the right hypochondrium, preceded at seven in the evening by a slight chill. There was no appreciable rise in the leukocytes. Gradually the pain became so severe that at 1 A.M., $\frac{1}{6}$ grain of morphine was given, followed by $\frac{1}{4}$ grain, without relief. The pain increased and another $\frac{1}{4}$ grain was given. The pain became so excruciating that the patient screamed loudly and begged to be put under anesthesia. Dr. Doyle was called and washed his stomach, with no relief. A duodenal tube was then passed. No relief was experienced when the tube entered the duodenum, but instant relief came within five to ten minutes after magnesium sulphate was introduced and bile began to flow. In half an hour he was perfectly comfortable. From a subnormal temperature before his attack the temperature rose abruptly during the attack to $106\frac{2}{3}^{\circ}$ F. and dropped again to 100° F. immediately after biliary drainage was established. Dr. E. went to sleep with the tube in place within half an hour. The tube remained in the duodenum overnight. The bile was very dark, very tenacious, cloudy and was a deep green-black. The next day he was fairly comfortable and the tube was kept in until 8 or 9 A.M. About 18 ounces of mixed bile was recovered during the night. The tube

was inserted again in the evening without washing the stomach. Bile flowed immediately after introduction of magnesium sulphate, but was not so dark. The bile was at first viscid but became progressively thinner and lighter in color as the drainage was repeated daily for four or five days, then every other day. The bile always gave positive cultures for typhoid bacilli, even up to Dr. E.'s discharge from the hospital, about six weeks later. The total number of drainages given in the hospital was about twenty-two. He went to Atlantic City immediately after his discharge, where his nurse gave him a drainage treatment two or three times a week for three weeks. Thereafter during that summer, in the White Mountains, he gave himself a treatment on three occasions. No final cultures were made from his bile. He has remained well for eight months, has been in active practice and says he feels perfectly well.

His history previous to typhoid fever was briefly as follows: He had had no infections, except that in Pittsburgh, in 1912, when he was a hospital resident, he had two gall-bladder attacks preceded by conjunctival jaundice. Roentgen-ray examination was negative. He was in bed for ten days each time. Between 1903 and 1907 he had recurrent attacks of follicular tonsillitis, but the tonsils were not removed.

Comment. This is a most important type of case in which this method of treatment has great promise. We all know how serious operative interference may be for acute conditions arising as complications during the acute and prostrating infectious diseases. Surgery has successfully managed some of these cases but the mortality has been high. But surgery, until recently, has been the sole choice and the risk taken was warrantable. Now we have an alternative choice, which can be more safely tried, and, if successful, the operative risk is avoided.

Secondly, this case teaches the lesson of the importance of the detection and treatment of typhoid carriers. This has been emphasized, too, by Nichols and others (3) and later by Henes. (2) Dr. E. is not yet safely out of the woods and should be reexamined for residual infection both for the sake of himself and of others. Nevertheless, Dr. E. has now remained well for over two and a half years.

Thirdly, this case is similar in its acute picture to 2 cases, within the past two years, of acute empyema of the gall-bladder which were successfully treated by this method: One in a man (see Case XVIII) who, for business reasons, positively refused the operative course advised him and the other in a woman who had such severe cardio-renal disease as to imperatively contraindicate surgery if there was any other acceptable alternative.

If the gall-tract in any given case can be made to successfully drain by this method the patient may be safely tided over the acute

phases. If it cannot be successfully drained, surgery becomes imperative. Naturally this method should not be advocated if there are no surgical contraindications, since otherwise surgery becomes the absolute choice of procedure providing *safe* surgical skill is available.

Report of Case VIII.—Illustrates a case of biliary fistula persistently draining for eight years, and accompanied by severe attacks of gall-tract pain, closed for nearly two years with very marked lessening in frequency and severity of pain. This case also proves the ability of non-surgical drainage to drain the gall-bladder *per se*.

(Case No. 1023).—Mrs. R., aged thirty-three years, referred to me on August 6, 1920, was operated upon eight years ago for empyema of the gall-bladder. A cholecystostomy was done but a biliary fistula developed through which she was drained constantly for *eight years*, with the exception of several weeks, when the sinus remained closed following cauterization. She has worn a dressing pad constantly, and during this period has not remained pain-free for longer than a month, and usually has had recurrent attacks of the upper right quadrant pain referred around the costal margin to the right shoulder blade every four to twelve days. Five years ago, for the relief of pain, she began to use a small silver catheter, which was introduced into her gall-bladder every night and morning by her husband, who had become most expert with it. It was noticed that she was more liable to be pain-free when bile was recovered by the catheter, but when thick white mucus and no bile was aspirated a pain attack very quickly followed. This suggested that the cystic duct became blocked by mucus secreted by the racemose glands at the neck of the gall-bladder and a hydrops of the gall-bladder would probably have followed if this mucus could not find an exit by way of the fistula. During these pain attacks there was frequently associated chills and fever for a day or two, with stiffening of the upper right rectus. Another surgeon (who referred the case to me) had watched the patient through many such attacks for three years and had made several attempts to close the sinus tract by cauterization, but with no permanent success.

When she first presented herself I catheterized the gall-bladder, and by means of a small syringe obtained a greenish-brown bile (with much mucopus flocculations in it), for culture and cytological examinations. The latter showed most beautifully the type of tall columnar bile-stained epithelium which I had previously seen in many other cases, and had, I think, learned to correctly

classify as gall-bladder epithelium on account of its height and its tendency to break off from the basement membrane at the reticulated folds of the rugæ and to become arranged in fan-shaped masses (Fig. 168). With this epithelium was found much inflammatory debris, pus cells and many colonies of heavily bile-stained bacteria. The following day we checked up our findings by duodeno-biliary drainage and recovered the *same type bile*, with the *same cytological picture* of the mucopus floccules, and Dr. Richardson recovered from cultures from both sources the *same bacteria* (and only them), namely, a hemolytic streptococcus and the *Bacillus coli communis*.

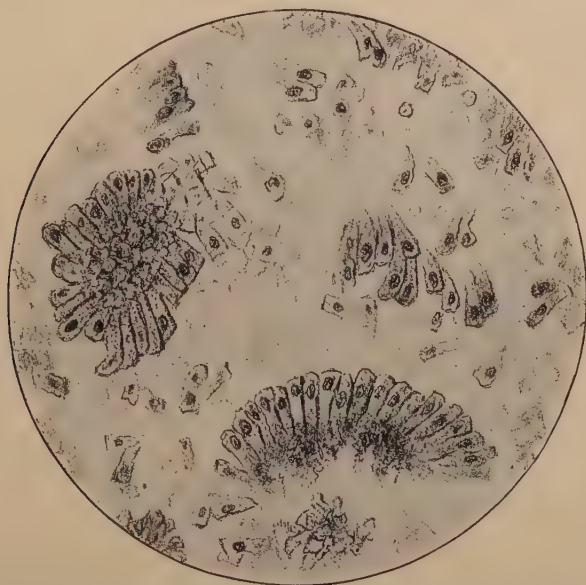


FIG. 168.—Heavily bile-stained tall columnar epithelium from gall-bladder. Note arrangement of cells in fan-shaped masses and clusters. Cells fairly well preserved with retained nuclei and comparatively little degeneration of cytoplasm. $\times 385$.

A gall-tract drainage was given every fifth day and each one was followed by an attack of upper right quadrant pain. This I have noted very frequently in many of the more acute cases of gall-bladder inflammation and perhaps more frequently with those infected with streptococci. This seems a natural result of making the inflamed viscus empty itself, but in all of my cases, except one (see Case XV), thus far, the pain following such drainage has become less severe until none is felt. After the third drainage and injection of vaccine, the sinus closed and except for one week *has remained closed since* (now twenty-two months), but two days later

an acute attack of pain occurred, with moderate fever, chills and leukocytosis and a surgical type of the upper right quadrant. There were no untoward developments after one week's hospital observation, and treatment was then resumed on the following basis: A duodeno-biliary drainage daily for three days, then twice a week for four weeks, every seven to ten days for another month and thereafter every three weeks. An autogenous vaccine was made and administered every fifth day, and at first gave rise to a definite focalizing gall-bladder pain, and after four months the strepto-

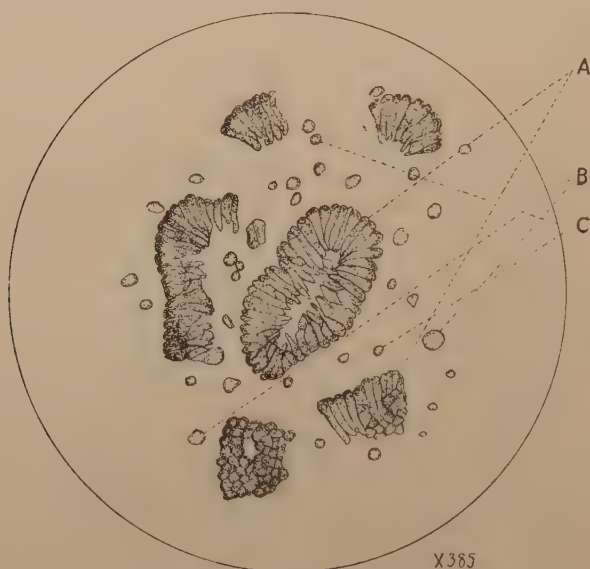


FIG. 169.—Catarrhal exfoliative cholecystitis; A, tall bile stained columnar epithelium from gall-bladder, arranged in fan shapes and rosette clusters; B, oval or cuboidal duodenal epithelial cells; C, pus cells or leukocytes, appearing much like duodenal cells but usually smaller. Note: The nuclei can be brought out by adding dilute acetic acid.

coccus disappeared from our cultures and since then on seven cultures made every third week only the *Bacillus coli* has been recovered. I have seen this disappearance of streptococci following autogenous vaccination and drainage in 12 cases of this series. Her pain attacks persisted after each drainage for the first month, but for the past seven months she has had none. Not only has she had a complete arrest of symptoms, but there has been a general systemic improvement in endurance, in color, in bowel function, appetite, sleep, and general sense of well-being. In addition, and this is the important point which I wish to stress, there has been a steady

though gradual disappearance of all the abnormal cytological findings from her bile. Her gall-bladder drains readily in response to magnesium sulphate and apparently continues to function normally between treatments, and I believe now that her focus of infection is nicely controlled.

In April, 1921, she sailed for Italy, taking with her a duodenobiliary drainage outfit, and was to give herself a treatment (as many patients have been taught to do) once a month. They find it very easy to do. I believe it to be a good prophylactic policy for them to follow and will guard against relapses.

May 5, 1922. Follow-up Notes. Uneventful, quiet crossing to Cherbourg and from thence to Paris. En route to Turin, twelve days after sailing, developed acute attack of upper right quadrant pain. Left train at Chambray for one day at hotel and then proceeded to Turin and went directly into a hospital, and during the first day at Turin the fistula reopened, and for two or three days discharged nothing but quantities of mucus. During this period she also became jaundiced, mild scleral jaundice, and one attempted drainage failed to recover any bile, suggesting common duct obstruction. During this time she had some fever for three days, but no chills or sweats. Duration of jaundice two days. After the fistula opened the pain subsided. After a week's rest in bed it closed again spontaneously and has remained so since. After this a second drainage was done in Turin with successful recovery of bile. Two weeks later, while taking mineral water similar to Carlsbad, fresh amœbæ, motile, were found in her stools, and subsequently she was given three courses of injections of emetin, subcutaneously.

No further attacks of pain occurred until early in September, and since then there have been slight attacks about every two months, September, December, February, and the last one on April 10, 1922. These have all been comparatively mild, lasting for about eighteen hours in the December and February attacks, but only about three hours in the April attack. There was no jaundice with any of these.

Since her departure a year ago she has taken only three drainages, one of which, in May, 1921, was unsuccessful, and two successful ones in Turin and in Rome early in June, 1921. Since then she has taken none. At the time of her departure she was having moderate attacks every three or four weeks, and the history of this last year has been distinctly more improved than at any time within the last eight years. Nevertheless I believe that this patient will eventually require further surgery unless she can be kept under closer observation. She may have calculi, not disclosed by roentgen-ray.

Comment. I have recited this case because it has been one of great interest and instruction. First, because I was able to obtain

bile by direct catheterization from the gall-bladder for microscopical examination and culturation; and, secondly, because of the recovery by the duodenal route of the same type bile with identical cytology and bacteriology we have again satisfied ourselves that this method of diagnosis and treatment is fundamentally correct, and is, moreover, a practical and efficient procedure; and, third, that a bacterium thus isolated in pure culture, and given as a vaccine, has a definite and specific therapeutic value in closing a sinus and overcoming a focus of infection in the gall tract; and, finally, that the possibility of the specificity of the bacterium is enhanced if it gives rise to a focalizing reaction which reproduces one or more of the presenting symptoms.

I have successfully closed by this method another case of persistent biliary fistula of months' duration, this second case being infected with *Staphylococcus aureus* and *Bacillus coli*. This patient has now remained well for nearly three years.

Reports of Cases IX and X.—Illustrate the value of non-surgical biliary-tract drainage not only from a diagnostic standpoint in supplying the surgeon with important and detailed information, but also from a therapeutic standpoint in preparing the operative field for safer surgery.

(Case No. 1033).—Mrs. E. R., aged forty years, was referred to me on August 19, 1920.

Chief Complaint. Pain in the right upper abdomen radiating to the back.

Family History. Father dead; renal, aged fifty-three; mother dead, cancer of breast, aged fifty-six years.

Present Illness. Attacks of acute epigastric pains, stabbing and grinding for six years; vomiting of undigested food two or three times a week, but during the past six months the picture changed and she had had about once a month severe attacks of nocturnal colicky pain in the right hypochondrium, radiating around the right costal margin. No jaundice but sallowness at times. Frontal headache and at times occipital. Eggs and beef disagreed. She became easily tired and was drowsy most of the time. There was epigastric bloating relieved by belching and epigastric pressure gave slight relief. The pain is generally nocturnal and unrelieved by food-taking. Vomiting of food as eaten, with bile and mucus. Constipation was obstinate. Mouth negative, except coated tongue. The abdomen was diffusely tender at McBurney's point and under the right costal margin, but the gall-bladder was not palpable.

In two attempted successive biliary drainages the gall-bladder failed to drain at first, and in the second only 32 cc of dark green

turbid bile were recovered. At the same time the patient had an attack of pain similar to the previous attacks. Many cholesterol crystals were found in the bile and much amorphous bile salts. Culture: *Bacillus coli* (heavy growth).

Urine. Negative; 90 per cent elimination of phthalein in three hours (80 per cent in two hours). *Blood.* Hemoglobin, 85 per cent; white blood count, 7100.

Comment. An operative decision was made for this patient on the following grounds: She presented a clear-cut picture of gall-stone colic with increasingly frequent attacks. Her diagnostic drainage suggested a partially obstructed cystic duct and showed an infected bile microscopically suggestive of cholelithiasis. I believe all definitely proved gall-stone cases with *irritable* gall-bladders and infection should be operated upon unless there are operative contraindications present which may jeopardize the life of the patient. I am still in doubt as to the wisdom of routinely insisting that definitely proved gall stones, when quiescent and with no history of previous activity, is, *per se*, an operative necessity. I believe there is no cure for gall stones except the knife when skilfully used, and that the presence of calculi increases the likelihood of cancer of the gall-bladder. I believe that gall stones in the presence of active infection make the gall-bladder more irritable and increase the tendency to colic attacks and to traumatization of gall-bladder tissue which may accelerate cancerous growth. Therefore such cases more imperatively require operation. But I further believe that preoperative diagnostic drainage will be of great service to the surgeon in suggesting what may be found at operation; that the fact that obstruction of the cystic duct preoperatively ascertained will be advantageous to know; that the determination preoperatively of the presence and the nature of the infection by cultural identification (to be checked up during operation) will be information of great importance to the surgeon in guiding him in what operative procedure to adopt, and especially will this be true if the preoperative study suggests the presence of duct infection in addition to bladder infection, calculus formation or obstruction of the cystic duct.

Finally, I believe that no case falling in this group should fail to have a postoperative study within two months after operation, and if catarrh or infection is still demonstrable duodeno-biliary drainages should be instituted and continued until normal findings are secured. Indeed, prophylactic drainage might well be given once each month to forestall a relapse even in a surgical case apparently cured. It is true that in a number of instances I have recovered very small stones through the tube and larger stones from the sieved stool following a diagnostic drainage; but there are

doubtless others left behind, especially so if faceted stones are recovered; yet I certainly do not advocate this method in the treatment of restive cholelithiasis, because I see the possible danger of perforating a cystic or common duct with a stone impacted in it.

To continue: Operation on this patient early in September, 1920, disclosed a gall-bladder containing 32 stones, brown, hard, faceted, pea to marble size (Fig. 170). One stone in the cystic duct partially occluded it. A cholecystostomy only was done. Culture at operation, direct from the gall-bladder, recovered *Bacillus coli* only.



FIG. 170

Postoperative study, ten weeks after operation: Gall-bladder drainage gave 50 cc golden-brown, viscid bile, flowing intermittently. Microscopically: Cholesterin crystals and some amorphous salts. Culture: *Bacillus coli*.

Further Comment. I am presenting this case to illustrate the points that symptomatic relief is not always a cure. The removal of the stones gave symptomatic relief, but the subsequent finding of the same organism, and the same inability of the bile to hold its salts in solution, is far from a cure of the condition. All the factors that are theoretically necessary for the production of stones are still present, and there is no assurance that they will not reform. In this group of cases postoperative biliary drainage by this method, from time to time, has served to clear up the remaining evidence of disturbed physiological chemistry and bacteriology in a number of cases.

Report of Case X.—Also illustrates the usefulness of therapeutic non-surgical drainage continued postoperatively to prevent relapse from residual infection, and thus make one operation suffice to bring about a real cure.

(Case No. 1022).—Mr. E., aged twenty-nine years, was referred to me on August 5, 1920. He presented historically a mixed syndrome of a gnawing pain-distress in the epigastrium, occurring two or three hours after meals, relieved by eating or alkalis, but followed by post-meal belching and upper abdominal distress. These symptoms first appeared about one year ago and have been featured by their intermittent appearance and spontaneous total remission.

His *past history* brought out the following important points: He was a "blue baby" for several months, but apparently recovered without serious damage to his heart. He had been subject to recurrent attacks of tonsillitis every winter for several years. In 1918 he had a severe attack of pandemic influenza, with chiefly intestinal focalization. In 1902 and again in 1906 he had suffered attacks of typhoid fever, both apparently genuine, but not accompanied by relapse or complication. Furthermore, his story suggested there was a possible typhoid carrier in his family, inasmuch as he said that his mother had had typhoid fever three times, and one brother and sister each had had one attack. He, himself, had been subject to bronchitis for years.

On *physical examination* the positive findings were as follows: Two dead and many decayed teeth requiring fillings, but no root abscesses. His tonsils were badly diseased and infected. He had chronic bronchitis with musical dry rales. There was slight rigidity of the upper right rectus, but no tenderness. The gall-bladder was not palpable. By "tuning-fork auscultation" there was definite transmission of the gastric note to the left edge of the right costal margin, but not transmitted through the liver.

As a result of *technical examination* we found that Mr. E.'s stomach had escaped organic damage, but showed a fractional curve of hyperchlorhydria, with the suggestive extragastric terminal elevation. He gave evidence of an exfoliative duodenitis and a catarrhal and infected cholecystodochitis, with pericholecystic adhesions obstructing the cystic duct. Cultures from this bile recovered a hemolytic streptococcus and *Bacillus coli*. The roentgen-ray study of his gastro-intestinal tract was reported summarized as follows: "Duodenal ulcer with periduodenal adhesions. The gall-bladder is not visualized." We, however, were unable to develop clinical or laboratory evidence to support this diagnosis of duodenal ulcer and felt that we had to deal primarily with an infected gall tract with periduodenal-cholecystic adhesions.

As a *preliminary plan of treatment* he was referred for the necessary dental work, and his tonsils were taken out, 50 per cent of the crypts were cultured, and a pure culture of hemolytic streptococci, like that isolated from his bile, was recovered and the two were mixed and used as a vaccine.

After several therapeutic duodeno-biliary drainages had been given him we noted the fact that only one out of five recovered "B" or gall-bladder bile, and increased my conviction that the cystic duct was obstructed and, although he had made some improvement, I referred him to Dr. Despard for operation, December 1, 1920. At operation my diagnostic conception of the case was verified. He was found to have no evidence of duodenal ulcer, but running from the lateral and anterior surface of the second portion of the duodenum to the mid-region, and to the neck of the gall-bladder were fine bands of adhesions which angulated the gall-bladder at two points. The gall-bladder was long and distended and could not be emptied by digital pressure. The gall-bladder was opened and a culture taken from which the hemolytic streptococcus was alone recovered. The mucosa was reddened and granular but not of the strawberry type. The cystic duct was probed and found obstructed just below the neck of the gall-bladder at a point where the adhesions were attached. In freeing the adhesions the gall-bladder was so badly traumatized that it seemed wise to remove it. The patient made a good postoperative recovery for two months, but then partially relapsed, and, on reculturing his bile, the *Streptococcus hemolyticus* was again recovered, together with *Bacillus coli*, and the duct bile microscopically still showed the inflammatory findings of a residual duct infection. Postoperative duodeno-biliary drainage was then instituted at weekly intervals and the new vaccine administered with prompt symptomatic response, and at the end of ten treatments the streptococcus disappeared from the cultures, and a month later the bile was reported sterile and has remained so since. The positive cytological picture of residual duct catarrh also cleared up by degrees and is now normal, although he has had no treatment for eighteen months, and the patient is perfectly well and 15 pounds heavier. It is interesting to note that the typhoid bacillus was not recovered from his bile by tube drainage or at operation.

Comment. This case again illustrates the importance of realizing that the so-called duodenal ulcer syndrome, based largely upon the history when unsupported by other clinical or laboratory data, bears an unreliable reputation and will trap the unwary or careless diagnostician. We must learn that the one- to three-hour postmeal epigastric empty distress, or so-called hunger pain, does not necessarily mean ulcer even when the pain is relieved by eating or the use of alkalies or antispasmodics, but should rather be thought of as a *mixed syndrome* in which duodenal irritation short of ulcer, with or without adhesions, cholecystitis and appendicitis, or combinations of them, must be differentially proved. Rarely, as Eusterman has pointed out, (1) benign gastric tumors may simulate the so-called duodenal ulcer syndrome.

The second diagnostic lesson this case teaches is that the roentgen-ray diagnosis of duodenal ulcer cannot always be separated clearly from duodenal adhesions and that the final diagnosis should be made by adjusting a proper balance between the history, physical findings and the data obtained from laboratory studies.

The third diagnostic lesson taught us by this and other cases is that when we fail to recover "B" or gall-bladder bile after *several* attempted drainages it is strong evidence in favor of an obstructed cystic duct or a fibrous, atrophic functionless gall-bladder or one filled with stones and containing no bile. This is diagnostic evidence of great value to the surgeon when preoperatively secured.

The therapeutic lessons we learned from this case and others similar to it are:

First. That the great primary essential in the treatment of these cases, whether medically or surgically managed, is to first remove all foci of infection higher up which may have caused (or may retard the healing of) the lesion in the upper right quadrant.

Second. That this method of non-surgical biliary drainage is not therapeutically applicable to *gall-bladder* disease in which the cystic duct is obstructed in such a way that the gall-bladder is unable to discharge its fluid contents.

Third. That this method of non-surgical biliary drainage has a very large and important field of usefulness in postoperatively continuing the surgical principles of free drainage in such cases in which surgery alone has failed to eradicate all residual infection. Duodeno-biliary drainage, together with the use of autogenous vaccines, will prevent many of these cases from relapsing and will relieve both the surgeon and the patient from the vexatious and dangerous necessity of reoperation.

November 20, 1922, Mr. E. writes: "I am feeling fine with no evidence of my old trouble. Weight 185 pounds" (gain of 24 pounds).*

* Compare with Report of Case XXVII.

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CHAPTER XXIX.

REPORTS OF CASES.—(CONTINUED.)

Report of Case XI.—Illustrates a case of cholelithiasis improperly and unwisely selected for non-surgical drainage, together with the risks attached thereto.

(Case No. 1179).—Dr. S., aged twenty-nine years, first seen June 20, 1921.

Family History. Negative.

Past History. Scarlet fever at six years, influenza, two attacks, September, 1918, and February, 1919, with slow convalescence from second. No bronchitis with either. Many "dry" boils on skin in past year.

Was out of school during 1914-1915 with "stomach trouble," vomiting and inability to digest food. Attack lasted three to four months, during which he lost weight to below 100 pounds from his normal of 135.

Recent History. Has been perfectly well (aside from above) until February, 1920, when he had first acute attack of upper right quadrant pain which awakened him some time after midnight. Relieved by morphine sulphate gr. $\frac{1}{4}$ (hypo) and hot applications. Twelve attacks during succeeding fourteen months, all similar, occurring during evening or night hours, but usually after midnight. Forced vomiting of food, no bile. Morphine gr. $\frac{1}{4}$ to $\frac{3}{4}$ by hypo and opium gr. 2 needed to control pain.

Two attacks have been followed by streptococcic sore throat, with marked swelling, especially of floor of mouth, septic fever and sweats. The last one pronounced Vincent's angina.

Present History. Four severe attacks in past six months, the last requiring $\frac{3}{4}$ gr. morphine and 2 grs. opium to partially control pain. Vomiting induced. Food, no bile. Never jaundiced although stools have bordered on clay color for a short period following recent attacks. Loss of endurance and lack of ambition. Easily fatigued. Bowels moderately constipated, although once a day. Bloating; no belching; no flatulence. All pain localized to right costal margin. Loss of weight from 140 to 130 in six months. Great ice-cream eater, but always disagrees. Pork too. All other foods agree.

Physical Examination. No jaundice of eyes, palate or skin. Tonsils infected, cryptic, pus expressed. Teeth negative; glands

negative; lungs and heart normal. *Abdomen:* Distinct localized tenderness at gall-bladder point, although gall-bladder not palpable. Upper right rectus rigidity +2 and upper left rectus +1. Tuning fork test for adhesions: note well heard from stomach through liver, suggesting dense adhesions. Stomach apparently pulled to right across midline. Doubtful tenderness over McBurney's point. No rigidity or spasm.

Technical Examinations: Gastric Analysis. Fasting twelve-hour residuum normal except for subacidity, biliary reflux, mucus (excess) and occult blood +1.

Microscopy: Pus cells +3, mucus strands +2, oral epithelium +1, gastric epithelium +2. Bacterial flora increased—masses, colonies and clumps of cocci.

Digesting: Prompt gradual harmonic response to free HCl 65, total acidity 105 at seventy-five minutes, curve thereafter remaining at this level for two hours, with moderate mucus and occult blood in 6 or 8 specimens from plus one to two.

Biliary-tract Drainage. Fasting residuum practically the same. Biliary reflux occurring during lavage. Duodenal entrance time thirty minutes. Duodenal fraction negative. Oddi's sphincter relaxed without stimulation.

"A"—common duct fraction—not estimated. (Duct open.)

"B"—common duct and gall-bladder fraction—75 cc green-brown, viscosity +2, mucopus floccules showing bile-stained pus cells +1, cholesterin crystals +4, bile pigment +4, leucin crystals +2. Bile-stained mucus. Bacterial flora increased—bile-stained masses, colonies and clumps of cocci.

Cultural identity: non-hemolytic streptococcus and staphylococcus aureus.

"C"—hepatic duct and liver fraction—30 cc lemon-yellow, turbid. Occult blood negative in all fractions.

Stools. Formed, moderate mucus, bile present. Occult blood negative. Microscopy negative.

Blood. Hemoglobin, 95 per cent (Dare). White blood cells, 11,040; polymorphonuclears, 74 per cent; transitionals, 0; large mononuclears, 3 per cent; lymphocytes, 23 per cent. Platelets normal.

Urinalyses. Negative.

Roentgen Ray. Negative for gall stones or gall-bladder and gastro-intestinal tract pathology.

Diagnosis: Major. Infective cholecystodochitis with potential calculi.

Contributing. Infected tonsils. Infective gastritis with gastric erosions. Dysfunction Oddi's sphincter. Chronic appendiceal irritation.

Treatment Outlined. Removal of tonsils with culture; non-surgical drainage; combined autogenous vaccine from tonsils and gall tract; restriction in fats; watchful waiting as regards gall-tract surgery.

Progress of Case. July 2, 1921, tonsillectomy. Cultural report: Hemolytic streptococcus pure. Vaccine prepared and mixed with streptococcus and staphylococcus recovered from gall tract. Injections every fifth day. Twelve therapeutic drainages between June 24 and October 10. During the night following several of these drainages acute gall-stone colic attacks occurred, some requiring

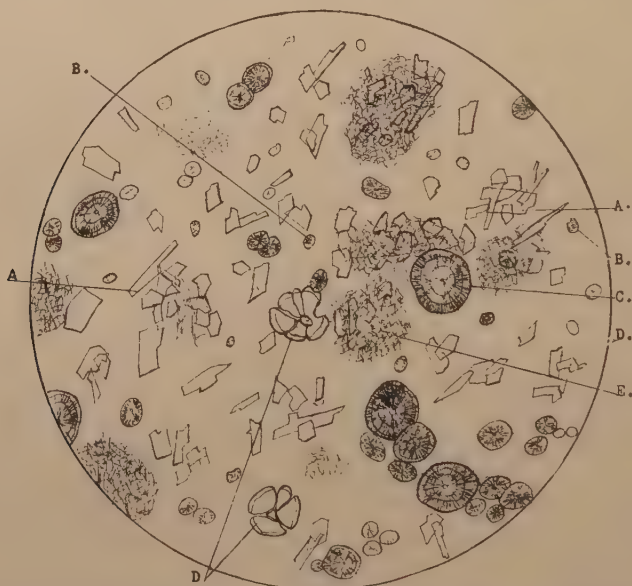


FIG. 171.—Dr. S., July, 1921. "B" fraction supersaturated with various crystals. $\times 385$. A, Cholesterin and calcium crystals; B, pus cells; C, leucin (?) crystals; D, leucin crystals undergoing spontaneous fracture; E, masses of bile pigment.

morphine. On two occasions no "B" fraction obtained. (Query: Was gall stone impacted in neck of gall-bladder?) No cytological evidence for inflammatory cystic duct obstruction. On four drainages deep green-black viscid bile recovered with numerous mucopus floccules showing exfoliated, tall columnar epithelium, pus cells, and all fields contained excess of cholesterin, leucin and bile pigment crystals. (Fig. 171.)

Due to these findings, although roentgen ray was negative for stones, operation was advised and strongly urged, but declined because the doctor had been absolutely pain-free and distress-free since attack of October 4. He had gradually resumed his old dietary

indiscretions, ice-cream at night, etc., without any effect. This represented a seventy-day symptomatic cure, but objective findings on last examination of October 10 were still positive for inflammation, infection and crystals.

He remained well until January 5, 1922, when on a pleasure trip, was taken with severe gall-bladder colic without any preceding symptoms or any exacerbation of infection. Pain excruciating, lasting a week, with evening temperature to 102° and sweats. Went to Washington, D. C., and was operated January 13 by Dr. George T. Vaughn.

Operative Findings. Gall-bladder densely adherent to liver and surrounding structures (note preoperative tuning fork test for adhesions). Gall-bladder intensely inflamed, in places very thin, in others quite thick. Dr. Vaughn feared it would rupture during removal. It contained a small amount of pus and two round stones, measuring respectively 1.5 cm. and 1.25 cm. in diameter. Both



FIG. 172

stones (Fig. 172) have a roughened mulberry surface, yellowish-gray, and show numerous flattened surfaces where they temporarily came in contact with one another.

Appendix found diseased, suggesting acute exacerbation of an old chronic process and was removed.

The patient developed an ether bronchitis and on fourteenth day broke open his incision part way through muscle layer, and two months later still had an incisional discharge but no biliary fistula.

During convalescence had three attacks of stomatitis similar to previous ones, except that they were less severe, the last being the mildest. Two months after operation had had no further pain or distress, and had resumed full diet. The patient did not return for postoperative drainage recheck.

Further Postoperative Study of Stones. Scrapings made from outer surface of stones for microscopical crystallography show a mixture of cholesterin, leucin and bile pigment crystals which are

almost identical with those secured preoperatively by non-surgical drainage (see Fig. 171 and compare with Fig. 173).

Discussion. This case illustrates the following points.

1. Wrong selection of a patient for whom non-surgical drainage could not be considered as a curative measure. It would have been better judgment to have *insisted* on earlier operation, for the patient showed no contraindications for immediate surgery, and as it turned out the gall-bladder was dangerously near gangrene and perforation. But the roentgen-ray negation of gall-stone shadows

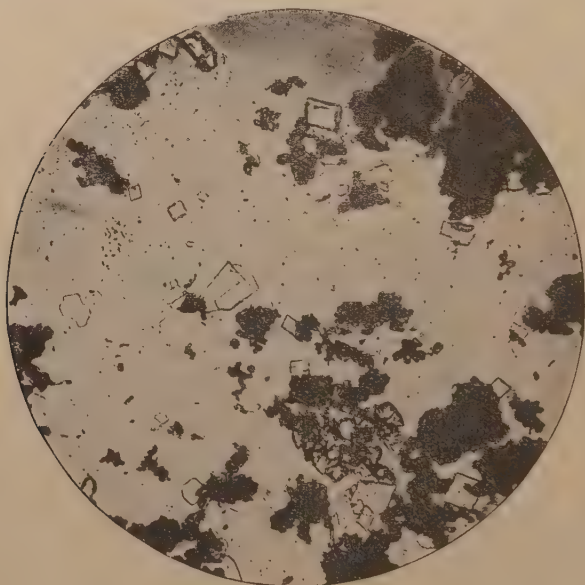


FIG. 173.—Photomicrograph of crystals recovered from "B" fraction of Dr. S. Note: It is very difficult to photograph the fields from biliary-tract drainage and show details on account of inability to bring all cells, etc., into the same focus. $\times$ 385. Compare with drawing—see Fig. 171.

suggested that the objective findings might indicate only gall sand or potential calculi, and the acute attacks of colic might be due to passage of these small particles from an acutely inflamed gall-bladder.

2. Diagnostic error of roentgen ray in inability to demonstrate stones (even negative shadows), or a pathological gall-bladder or inflammatory adhesions.

3. The ability to preoperatively diagnose by non-surgical drainage potential calculi, and thus strengthen a presumptive diagnosis based on the history.

4. The connection between cause and effect. Infected tonsils, streptococcic throat, streptococcic gall-bladder and stones.

5. The possible inference that the numerous flattened areas on otherwise round stones indicated a restless turning of the stones producing a gall-stone colic as a result of an inflamed and irritable gall-bladder, stimulated to a contractile effort by magnesium sulphate. During the quiescent periods the stones rested quietly against one another sufficiently long to cause each flattened or depressed area.

6. The danger of attempting to treat such a gall-stone case by non-surgical drainage beyond a period intended to prepare the surgical field.

Note. Such a patient should certainly resume postoperative non-surgical drainage.

Report of Case XI-A.—Illustrates a characteristic case of atony of the gall-bladder; its sometimes confusion with mechanical cystic duct block; the symptomatic improvement secured by non-surgical drainage and, finally, a case wrongly selected for surgery as a contrast to Case XI.

Mrs. M. R., aged forty-four years, was referred on May 25, 1920.

Chief Complaints. Sour stomach; excessive belching; constipation; excessive daytime drowsiness, melancholia; nocturnal insomnia.

Family History. Negative.

Past Medical History. Recurrent tonsillitis. Abscess in left ear in 1912.

Operations. 1900—Appendectomy, right salpingo-oöphorectomy. 1902—Curettage and cervical and perineal repair. 1914—Left salpingo-oöphorectomy. At last operation a pelvic horseshoe kidney was found.

Present Illness. Constipation for twenty-years. No natural movement in five years. Laxative habit—Turrell's cascade habit for five years. Hemorrhoids. Progressive belching, progressive intestinal flatulency. Afraid to eat on account of abdominal distress. Sweets, candy, especially chocolates, bacon, sugar, starches, as fresh bread or pastry, and all sour foods disagree. Says cream makes her "dopy." Severe headaches, chiefly orbital, in cycles, relieved by calomel. Epigastric distress, constant for weeks at a time, then suddenly ceasing; one to two hours after meals, relieved by food taking and soda bicarbonate and by belching. During attacks of migraine stools are very light yellow.

Physical Examination. General appearance, "fair, fat, forty." Tonsils retracted, sclerotic, but clean. Teeth, gums, sinuses, bronchial tree negative. Lungs normal. Heart normal. Pulse, 78;

blood-pressure, 130/82. Abdomen: slight upper right rectus rigidity, but quite definite tenderness over gall-bladder point. Gall-bladder palpable (?). Ulnar concussion gives pain. Stomach pulled to right (?). Adhesions suggested by positive tuning fork test to right costal margin. Marked eructation of gas after examining stomach, and marked gas audible in stomach and duodenum. Spinal tender point eleventh left thoracic vertebra, transverse process.

Laboratory Examinations. Blood: Hemoglobin 86 per cent (Dare); white blood cells, 6800; polymorphonuclears, 62 per cent; transitionals, 4 per cent; large mononuclears, 6 per cent; lymphocytes, 28 per cent. Wassermann negative.

Kidneys. Urinalyses (repeated), all normal. 'Phthalein 60 per cent.

Stools. Negative except for stasis and deficient bile. Occult blood 0. Intestinal motility test to carmine: Appearance time forty-two hours, disappearance time ninety hours +. Incomplete evacuations. Six stools.

Fractional Gastric Analysis. Typical extra-gastric curve with hyperchlorhydria. Stomach negative, clean. Occult blood not present in any fraction. Motility normal.

Duodeno-biliary-tract Drainage. Delayed entrance time thirty-five minutes. Normal duodenal fluid. Occult blood 0. Normal "A" and "C" fractions. No "B" fraction was secured, but negative microscopy for suggestions of intra-duct obstruction to cystic duct. Cystic duct blocked by adhesions? Cytology of "A" and "C" biles negative. Culture from duodenum and "A-C" fraction: No pathogenic organism.

Roentgen Ray. Probable gastric ulcer, with incisura on greater curvature near pylorus. Spastic colon. Intestinal stasis. Gall-bladder not visualized. Negative for gall stones.

Diagnosis. Gall-bladder atony *versus* mechanical obstructions to cystic duct. Biliary migraine. Hepatic-intestinal toxemia.

Treatment. Gall-tract drainage at weekly intervals. Diet: Restriction in fats, carbohydrates, sugars. Medication: Pancro-bilin, senna agar fruit paste. Reducing exercises.

Progress of Case. No "B" fraction recovered until *fifth* drainage, when small amount of heavy black bile recovered. Culture: Non-hemolytic streptococcus and B. coli. Cytology negative except for low grade inflammation. Negative crystallography. Vaccine prepared and administered. At the end of two months gall-bladder was emptying well on each drainage, with "B" fraction averaging 60 cc and becoming progressively less static. By this time marked symptomatic improvement. Reduction in weight 10 pounds in two months. Diminution in headaches. Clearing up of confused

mental state; drowsiness replaced by alertness; depression and melancholia gone. Patient cheerful and optimistic. Bowel movements 2 to 3 daily *without any laxative*; senna agar fruit paste withdrawn, pancrobin reduced. Drainages gradually decreased to every three months. In April, 1921, repeat cultures were negative for streptococcus, though *B. coli* persists.

From April, 1921, to May, 1922, this patient remained in perfectly satisfactory health with an office drainage every third or fourth month, and an occasional home drainage when she felt it necessary. In May, 1922, remarried. Husband desired a perfectly well wife, freed from the annoyance of continuing tube drainages. Consulted a surgeon, who advised cholecystectomy as a permanent means of relief. Operation decided upon, and after preliminary survey, especially devoted to kidneys and myocardium, the patient was considered to be a much more than average safe surgical risk.

Operation. June, 1922. Ether anesthesia, well given and taken. Upper right rectus incision. Stomach and duodenum explored and found negative except for adhesions between duodenum and gall-bladder. Gall-bladder was of a normal bluish-gray color, slightly thinner walls than usual, and having a band of adhesions midway between the fundus and neck, which sharply angulated it by extending to the liver. The gall-bladder contained no stones, nor were any stones felt in common or hepatic ducts. Gall-bladder expertly removed in usual manner. Unusually satisfactory surgical exploration.

Postoperative Notes. This patient's ether recovery was entirely normal, and postoperative recovery uneventful until 7.30 the following morning, twenty hours after operation, when she began to have slight spasmodic twitchings in her right hand, and a tendency to spasm of the fingers. Her temperature rose to 104° F. and kept steadily rising to slightly over 106° F. She lapsed into unconsciousness and died at 7 P.M., thirty-two hours after operation. Her *preoperative urine* was perfectly normal except for low specific gravity. Her 'phthalein output was 65 per cent. Her *postoperative urine* by catheter showed a +4 acetone and granular casts. Surgical opinion was that the cause of death was either an acute uremia or a cerebral embolus.

Comment. This case is reported to illustrate the following points.

1. Gall-bladder atony, with musculature gradually responding to magnesium sulphate stimulations so that on the fifth drainage gall-bladder fraction appeared, and thereafter was almost without exception obtained. From this standpoint I question whether the duodeno-gall-tract adhesions could have been responsible for the failure to recover gall-bladder bile. Prompt symptomatic response after gall-bladder drainage had become established, with positive culture obtained from "B" fraction, previously negative

2. Note the clinical evidence of adhesions as suggested by positive tuning fork test, substantiated by roentgen-ray suggestion of pyloric ulcer, producing an incisura, which was probably due to adhesions rather than to ulcer.

3. The unexpected surgical risk, which is occasionally encountered even in a patient who presents *no* surgical contraindications. There was no imperative necessity for operating upon this patient. There were no stones, the gall-bladder was not extensively diseased, indeed seemed relatively normal except for thinned walls, and the adhesions were not acutely inflammatory nor obstructing the excretory channels. The pancreas was normal. This patient was in comparatively comfortable health at her worst, and was distinctly above the average at her best, and could probably have been kept in reasonable health by occasional non-surgical gall-tract drainage.

4. To contrast this case with Case XI, one illustrating a patient for whom earlier operation would have been more advisable than continuing non-surgical drainage, and the other, a patient for whom surgery should not have been selected.

Reports of Cases XII and XIII. - Illustrate the fact that calculi can be made to pass out of the gall-bladder or ducts by non-surgical drainage, but at a risk which does not justify the procedure.

R. L., aged twenty-six years, Phillipino mess attendant. Seen in Naval Base Hospital No. 5, Brest, France, March 28, 1918.

Past History. In 1913 cholecystostomy and solitary gall stone removed. Since then several attacks of upper abdominal colicky pain, nausea and vomiting. No jaundice. Pain localized in gall-bladder region, radiates to right shoulder blade and occasionally downward to right iliac fossa.

Present History. Acute attack of clinical gall-stone colic, March 26, followed by jaundice.

Physical Examination. Tenderness over appendix referred during attack to gall-bladder region, later returning to right iliac fossa.

Laboratory Findings. Leukocytosis 16,000. Clay white stools, bile in urine.

Roentgen Ray. Blurred gall-bladder shadow. No stones visible.

Stomach. Negative.

Biliary-tract Drainage (Diagnostic): Common duct apparently blocked. No bile recovered for several hours. Acute colic developed requiring morphine. Tube retained and drainage established with subsidence of acute surgical right abdomen. Forty-eight hours later 2 triangular-shaped faceted gall stones, about 1 cm. in diameter were recovered from the sieved stool. On account of the facets

other stones were considered to be retained. Jaundice promptly disappeared the day following drainage and the second day following at operation by Dr. Le Conte, the common duct was found dilated and the cystic duct completely obstructed by a large solitary calculus, mulberry type, 2 cm. in diameter. The gall-bladder contained sand but no calculi.

Comment. It seems possible that the two faceted and one mulberry stone may have been in the gall-bladder, and the two smaller ones pushed out first and delivered as a result of drainage and the larger stone impacted in the cystic duct, or it may be that the two smaller stones were in the dilated common duct and the larger calculus already impacted in the cystic duct. In any case the magnesium sulphate drainage, together with the use of morphia, relaxed the common duct during an acute stone colic and permitted the expulsion of two stones.

The patient made a perfectly acceptable recovery during an observation period of over one year.

Comment. This case and the next one following it have been mentioned merely to draw attention to the fact that it has been proved possible to secure passage of a gall stone or stones from the biliary system (ducts or gall-bladder) by means of intra-duodenal treatment. I could cite several other cases similar to the two reported. In certain instances it has been possible to draw up through the tube very tiny gravel-like stones which are small enough to pass through the calibration of the duodenal tip and rubber tubing. Some of these will be found illustrated in report of Case II.

As stated on page 436, I consider it to be exceedingly poor judgment to attempt to treat any case of *active* gall stones by non-surgical drainage on account of the danger of possible perforation of the gall-bladder or cystic or common duct, *except* in a patient presenting such very evident and severe contraindications to surgical intervention as to make it appear likely that he or she would not survive the operative and anesthetic shock. In such a case it might seem justifiable to face the lesser of the two risks. The situation is somewhat different in a known case of gall stones, proved by roentgen ray, but gall stones which are *quiescent* and are not exhibiting any tendency to produce an acute colic, in a patient who is very toxic, and for this reason a less suitable subject for immediate surgery. In such a patient it may be possible to safely carry through a preliminary course of non-surgical drainage as a preparatory step, and by draining the liver and ducts reduce the toxemia and better prepare the surgical field so that the time elected for surgery will find the patient in a better state to withstand the operation.*

* See Report of Case XX.

CASE XIII.—I am indebted to Dr. J. S. Hart of Toronto, Canada, for the account of the following case, which I am setting down according to the following correspondence:

MARCH 1, 1921.

DEAR DR. LYON:

I wish to write you concerning a patient of mine. She first came under my care five years ago, aged twenty-four years, having an appendix removal three years previously.

She had been suspected of having had tuberculosis, but I never discovered any tubercular focus, though she had an almost constantly elevated temperature up to two degrees. She had a colitis for which a year later she had the side of the cecum drawn through an opening in the right iliac region for direct medication, but this procedure gave her little or no benefit.

Occasionally, before I knew her, she had biliary crises—supposedly, though not typical, of gall-stone colic—and for the past two years these attacks have increased in frequency in spite of the fact that in January, 1920, she had her gall-bladder removed. The gall-bladder was found thickened and with an abnormal amount of fibroid tissue, but no stones were found and a bacterial examination was not made.

Her hepatic crises have continued and during the last one or two she has had pain also in her right arm.

Almost every day she has some rise of temperature, one degree or more, not only when her seizures are on, but when she goes about in the intervals.

After the attacks, there is slight icterus and she also suffers at times from skin irritation.

The attacks of pain are at intervals of three to four weeks and are severe enough to require morphia. The liver is slightly large and there is tenderness over the part where the gall-bladder was.

She has had Wassermann examinations twice with negative results.

If you would drop me a line informing me as to your opinion I should be greatly obliged.

Yours truly,

J. S. HART.

On March 12 I wrote Dr. Hart giving him directions regarding the method of biliary-tract drainage, and stated that I judged his patient to have an infective choledochitis, cholangitis with biliary cirrhosis, and possibly with infection in the liver itself. I suggested a trial of biliary-tract drainage, taking of cultures and the use of vaccines, and stated that this case seemed to be not unlike that of Miss A. I. (see Case I), and urged perseverance in the plan of treatment which was carried out for her.

On August 13, 1921, Dr. Hart was kind enough to send me the following follow-up letter.

AUGUST 13, 1921.

MY DEAR DR. LYON:

I followed your directions with fair exactness, doing the duodenal lavage myself, with silvol as a subsequent antiseptic lotion. On several occasions the magnesium sulphate wash was followed by spasmodic pain. While the subsequent treatment was still in progress—but on the fourth or fifth attack

of pain and the tenth lavage—an unusually violent pain ceased suddenly, and the next day a stone the size and shape of a sparrow's egg was discovered. That was in the early part of May, and there has been no real crisis since. I cannot give you exact dates as I am from home on a holiday and separated from my records.

The lavage and vaccine were continued until she went away about the middle of June, but only a few days ago I had a letter from her reporting a gain in weight and an improved general condition. The infection was found to be streptococcal and the first specimen refused to grow by any device that the bacteriologist could apply. The cocci were reported to be in clumps and enveloped in a mucoid mesh or membrane.

The patient is better, hopeful and grateful.

J. S. HART.

Follow-up, February 12, 1923.

MY DEAR DR. LYON:

It is too bad that I must report to you a fall from grace on the part of my patient, the subject of your letter received today.

Following my letter of August 13, 1921, she was very well and in better health than for many years, but in the spring of 1922 she had a recurrence of her colic attacks, more frequently for the latter part of the period from then until now.

She is now out of the city and it has never been convenient to return to the lavage, though I do not doubt the advantage it had been to her.

J. S. HART.

See *Comment, Case XII.*

Report of Case XIV.—Illustrates the usefulness of *preoperative* non-surgical drainage in overcoming an acute and complete biliary obstruction, and thus converting a bad surgical risk into a relatively safe one.

Rev. D. J., aged fifty-six years, was admitted to the hospital, May 17, 1920, intensely jaundiced, following an acute attack of clinical gall-stone colic three weeks before. Since then the jaundice steadily increased and at the time of admission was complete, with acholic stools, bile-laden urine, and a leukocytosis of 10,600. Moderately elevated temperature, marked mental depression, intense drowsiness, itching skin, a greatly weakened myocardium, and deficient kidney function, with 'phthalein output of 35 per cent. Urinalyses containing hyaline and granular casts and a light cloud of albumin.

His previous history indicated a number of attacks suggesting gall-stone colic, but none followed by jaundice. The liver was enlarged, gall-bladder not palpable, but upper right quadrant showed distinct resistance and involuntary stiffening of upper right rectus muscle, associated with localized tenderness. His coagulation time was markedly delayed.

He was considered to have a stone impacted in the common duct,

but in view of the surgical risk non-surgical drainage of the gall tract was attempted in the hope that the stone might be dislodged and either pass out or bob back into a dilated common duct. On entering the duodenum no bile was secured until eighteen hours later, when the drainage fluids became faintly tinted, and very shortly afterward a large amount of bile was secured under considerable pressure, and in less than twenty-four hours over 3000 cc was evacuated. The liver rapidly decreased in size, and the jaundice cleared within several days, with marked improvement in cardiac action and renal function.

He was considered to be ready for operation, but unexpectedly declined and was given his discharge from the hospital on June 9, 1920, and returned to his work. Nothing further was heard from him except good reports until April 4, 1921, when he was readmitted with conditions that were very similar, although not quite so severe, and again he was brought up to a point where he was ready for operation by April 14, and again declined.

Nothing further was then heard from him until September 17, 1921, when he was readmitted and stated that he had had complete comfort until a few days before, when another violent attack of pain was followed by jaundice, which was as deep as that on his first admission. His physical findings were much as before. His leukocytes, however, were 18,320. His heart was acting badly and his kidney output was deficient, both for fluids and 'phthalein. After relieving the obstruction to his common duct, 4500 cc of very dark yellow-green bile, with numerous mucopus flocculations, showing inflammatory evidence, was drained out in twenty-six hours. Following this, intermittent drainage was carried on for several days, during which $5\frac{1}{2}$ liters of bile were removed. This was purely a presurgical measure to decrease his toxemia and take the strain off his heart, kidneys and liver.

Operation. October 19, 1921, by Dr. Despard. Ether anesthesia. Upper right rectus curved incision. Upper right quadrant viscera found bound down in mass of adhesions suggesting old inflammation plus a recent localized peritonitis. At first the gall-bladder appeared to be absent, but on later dissection a very small, shrunken, fibrous and atresic gall-bladder was identified, dissected free and removed. The duodenum and common duct were explored and no stone or stones could be found. The common duct was dilated and thickened. The head of the pancreas was very much enlarged and extremely hard. Unless a stone in the common duct had been passed during this last acute attack, no other finding other than the enlargement of the head of the pancreas, with perhaps an added inflammatory edema of the duct, would account for the complete common duct obstruction. The surgical exposure was extremely difficult on

account of the many adhesions and large amount of fat. The common duct was drained by a No. 13 rubber catheter, sewed in with medium hard ten-day chromic gut. The patient left the operating table in good condition and made a very satisfactory postsurgical recovery, and was discharged on November 17, 1921, following a check-up non-surgical drainage, which was negative for residual evidence of trouble.

Follow-up. February 7, 1923. By letter he reports in substance that he has experienced the best health he has known for fifteen years. He has preached, carried on revival services for weeks, and has closed the services with his usual energy. He says he is able to run up stairs like a boy, sleeps finely and eats anything.

Comment. This case has been selected from a number of others which are in a general way much like it, in order to illustrate how a bad surgical risk can be improved by a proper period of preliminary non-surgical drainage and converted into a safe table and post-operative risk.

Some diagnostic lessons are also evident in this case. The general picture of it suggested cholelithiasis with a ball-valve stone in the common duct, but no stone was found at operation, and the gall-bladder was found of a character scarcely possible of containing a stone. If a stone had been present, it must have passed out of the duct during the course of the last drainage, but escaped recognition in the stools, which were not as carefully watched as they should have been. If no stones existed at any time, the acute colic attacks which clinically so closely simulated stone colic must be accounted for on the basis of a double spasm with rise of intra-duct tension similar to that which I think existed in Case XXIII. Even so it seems doubtful that a spasm of Oddi's sphincter could continue long enough to produce a complete obstructive jaundice lasting several weeks, unless accompanied by extensive intra-duct inflammatory edema. It is conceivable that both of these conditions might respond to intra-duodenal treatment, by constant irrigation with hot solutions, including magnesium sulphate. If neither stone nor duct spasm and edema produced the obstruction, the only other factors which might have been operative were the enlarged head of the pancreas and the chronic inflammatory adhesions. It seems to me less likely, however, that either of these conditions could have been materially influenced by intra-duodenal topical treatment.

Report of Case XV.—Illustrates a fatal outcome of a case of acute and chronic cholangitis in a patient for whom neither multiple surgery, followed by non-surgical drainage, sufficed to save her life. It also illustrates the difficulties and dangers of multiple operations,

(Case No. 1009).—Miss N., aged thirty-four years, was referred to me on July 15, 1920. In November, 1914, a cholecystostomy was performed with the removal of a large stone from the cystic duct and many stones from the gall-bladder, followed by eighteen days drainage. The appendix was also removed. The surgeon distinctly remembers the gall-bladder was then thickened and shrunken. The patient remained well for three months, when she had a recrudescence of symptoms, a typical gall-bladder syndrome of non-colic type, with a dull aching from the right costal margin to the right shoulder blade. She had severe nausea, progressive anemia, and 20 pounds loss of weight. There was upper right quadrant tenderness and rigidity. The specific details of drainages were as follows: 90 cc to 200 cc of static, atonic, green-brown, cloudy, flocculent bile, emptying intermittently. The bile was infected (*Streptococcus hemolyticus* and *Staphylococcus aureus* and *B. coli*), contained pus and exfoliated bile-stained short and tall columnar epithelium, no crystals. The common duct was open. "C" fraction very bad, muddy, mucopus floccules plus, cytology pathological. Each of six drainage treatments was followed by gall-bladder pain and a vaccine focalizing reaction in the gall-bladder. She was sent to the Adirondacks for a rest, but came back unimproved.

Operation was decided on, the points of decision being: (1) Because she had had no relief after six drainages, a month's vacation and the continued use of the vaccine; (2) the surgeon's belief that the gall-bladder wall must be infected and that the gall-bladder must be shrunken and thickened beyond its appearance six years earlier. I believed, however, that the gall-bladder must be dilated and distended (*e. g.*, 90 cc to 200 cc of recovered "B" fraction bile at each drainage argued against the gall-bladder being contracted), and went on record to that effect.

Operation, September 27, 1920. (Cholecystectomy. The gall-bladder was found to be distended with thinned out wall, not shrunken or fibrous. Across the fundus of the gall-bladder, along the course of the previous drainage, was a band of adhesions between the fundus and the anterior abdominal wall, anchoring the gall-bladder. Every time this inflamed viscus tried to contract by itself or by magnesium sulphate, it was squeezing against a mechanical difficulty, therefore causing pain. There were numerous adhesions between the omentum and ascending colon and cecum, which either were not present at the removal of the appendix six years previously or had reformed. No adhesions were present in the neighborhood of the stomach or duodenum. The liver was normal in its gross appearance. The pancreas appeared normal. The surgeon remembered that the gall-bladder wall was thickened and con-

tracted at the first operation and was surprised to find it now thin walled and dilated. (Fig. 174.)

The gall-bladder was removed. Mucosa red, granular, but not of strawberry variety. Closed with gauze and rubber-tube drain.

Operative cultures directly from the gall-bladder grew out staphylococcus aureus and a few colonies of hemolytic streptococci. A section study from the gall-bladder wall *failed* to show bacteria in the wall.



FIG. 174

Comment. Should the gall-bladder have been removed in this patient? I believe that most of us today would probably say so. In this case, however, we had reason preoperatively to suspect that this patient's *bile ducts* were infected as much as her gall-bladder—perhaps more so. Her gall-bladder had preoperatively been proved to drain well by this method, notwithstanding the mechanical difficulty of dense adhesions. Might it have been better to have released the adhesions between gall-bladder fundus and abdominal wall, hoping that they either would not reform, or in a mechanically

different way, and to have left in the gall-bladder? Why? In order to take advantage of the increased possibility of flushing the ducts (when non-surgical drainage should be postoperatively instituted) by the *vis a tergo* action of the gall-bladder acting as a syringe bulb.

Unfortunately this patient made a poor postoperative recovery. At the end of seven weeks she was still having biliary vomiting, upper right quadrant pain and griping diarrhea. We too frequently see this occur in the cases that "go wrong" after operation. It is often due to residual infection in the ducts giving the infecting agent a great chance to disseminate the infection through the large and small bowel. Was this so in this patient?

She was again referred back for restudy and we found an acute duodenitis, a duct bile with catarrhal exfoliation, pus cells and bile stained colonies of cocci that returned a pure culture of hemolytic streptococci, the same organism isolated in her preoperative study. Certainly it would appear that she had a cholangitis. A new vaccine was made up and biliary-tract drainage was begun and seven were given from November 15, 1920, to December 7, 1920, with practically no improvement. The bile was deeper yellow than normal duct bile, was mixed with a heavy mucus and contained many mucopus flocculi giving cytological pictures positive for acute inflammation. During this period she was having nocturnal pain attacks, chilliness, low fever and sweating. On December 7, we found her common duct closed and plugged with mucus. Fearing that an obstructive chole-dochitis was impending she was sent to the hospital for a period of continuous drainage.

She entered the hospital on December 9, weighing 110 $\frac{1}{4}$ pounds and left on January 5, weighing 108 pounds. During this period she had continual drainage for eleven days, thereafter a daily three-hour drainage. During the period of continuous drainage the total amount of bile removed was 5565 cc, of which 1275 cc was secured during the day and 4290 cc during the night. It is interesting to note the increased amount of drainage secured by night, which is an argument in favor of continuous drainage. During the ten succeeding daily three-hour drainages the total amount of bile recovered equalled 945 cc. A new vaccine of hemolytic streptococcus obtained directly from her gall-bladder at her second operation was made up and administered during this period, and thereafter.

Cultures made from her bile on December 23 and 25, 1920, and January 4, 1921, were all negative for streptococci, both by culture and smear. At this time she was completely relieved of her pain, nausea, fever and her leukocytes dropped from 14,000 to 6,400, and her hemoglobin rose from 72 per cent to 85 per cent. At this time her improvement was very encouraging and she was advised to dis-

continue her work and return to her home and attempt to build up by rest, tonics and occasional drainage.

She then passed out of my personal observation.

Follow-up: July 22, 1921. Miss N. has not done well. She continued her home drainages for some time, but failed to improve materially, developed symptoms of pyloric obstruction and was operated for the third time on July 20, 1921. A perfect mass of adhesions were found between the bed of the gall-bladder and the pyloro-duodenal limb. The stomach was found in torsion and the anterior wall was adherent to the outer surface of the liver. This produced a kink in the first portion of the duodenum, causing a partial obstruction. The bile was described as being grossly normal in appearance, and the liver and pancreas were as noted in the second operation. A duodeno-duodenostomy was performed, but the patient died of peritonitis four days later.

Comment. The outcome of this case was a great disappointment. I doubt whether anything could have been done to prevent it. Still it is worth while contrasting this case with Cases I, XVI and XVII.

CHAPTER XXX.

REPORTS OF CASES.—(CONTINUED.)

Reports of Cases XVI and XVII.—Illustrate the usefulness and life-saving possibilities of non-surgical drainage, especially when given continuously in cases of grave *postoperative* cholangitis and toxic hepato-dochitis, upon whom multiple gall-tract surgery has been practiced without favorable results and for whom further surgery can offer little or nothing more.

(Case No. 1259).—Mr. W. A., aged fifty years, was referred to me on January 9, 1922.

Past History. Diphtheria. Typhoid fever at twenty years. No relapses. Jaundice many times. Influenza, 1921. Kicked by a horse in the upper right quadrant at thirty-five years.

Operations. April, 1916.—Excision of duodenal ulcer and pyloroplasty (?), cholecystostomy, appendectomy.

1921—Cholecystectomy and duct drainage for three weeks. At this time liver was said to be cirrhotic. Patient remembers that his tube drained about 24 ounces every twenty-four hours.

Present Illness. For twenty years sour belching, constipation with discharge of colon mucus. Much worse for past ten years. Since first operation the burning sore distress has been relieved, but belching continued. Constipation and colon mucus unchanged. Severe jaundice attacks began one year ago. After influenza, 1921, more jaundice, more constipated, more mucus, more upper right quadrant distress. Six months later, July, 1921, second operation with relief of none of these symptoms, but, in addition, had added attacks of agonizing upper right quadrant pain requiring morphine, and during past six months two very bad attacks of jaundice. Pain every one to four weeks lasting one to three hours, always requiring hypos. Only once fever and chills since second operation. He now knows when he begins "to fill up" in gall-bladder region. Says he has been too ill to work for four years. Loss of weight 21 pounds in six months.

Physical Finding. Obviously ill. Temperature 101°; pulse, 110; respiration, 21; blood-pressure, 114/86. Jaundiced. Heart: enlarged, myocardial weakness, rate irregular; poor quality sounds. Abdomen: Scaphoid. Liver small. Stomach pulled to right by

adhesions (?) Tuning fork positive along upper costal margin and through liver. Moderate rigidity. Tenderness at zone corresponding to the gall-bladder region. Eight inch right rectus scar with partial incisional hernia. Anal fistula.

Laboratory Findings. White blood corpuscles, 8,480; polymorphonuclears, 77 per cent; transitionals, 4 per cent; large mononuclears, 3 per cent; lymphocytes 16 per cent.

Stools. Fatty acid, soaps, unstriated muscle, starch, all + +.

Gastric Analysis. Fasting and digesting biliary regurgitation. Digestive hormonal response normal. Occult blood negative. Mucus increased.

Biliary-tract Drainage. Delayed duodenal entrance time. Duodenitis. Dysfunction Oddi's sphincter. Catarrhal infective cholangitis. "C" bile very much darkened to shade normally representing gall-bladder fraction. Very viscid containing stringy mucopus with exfoliated low columnar epithelium, pus cells +2, inflammatory débris, bacterial colonies. Culture: Heavy growth staphylococcus aureus from liver bile.

Roentgen Ray. Negative for calculi.

Treatment. Continuous drainage five and a half days, during which time 10,245 cc or something over $2\frac{1}{2}$ gallons of bile were recovered, with prompt subsidence in acute picture; then four-hour drainage every other day for one week. Went home very much improved. Quite over the acute cholangitis. Continued home drainage once a week with vaccine. Slowly improved for two months, then began to gain faster and resumed work. Gained 12 pounds. Every now and then would have "dead, sore, distended feeling" in liver and gall-tract region, which would be relieved by drainage every ten days. Discontinued drainage and continued to do well until a month ago, when developed severe, steady, non-colic pain, knotting, twisting, pulling pain requiring $\frac{1}{2}$ gr. morphine to control. Drenching sweats, moderate fever, jaundice, cloudy urine. Stools light in color, but not clay. Arrived here in acute pain February 1, 1923, one year after first presenting. Temperature, 102° ; pulse, 124; leukocytes, 8,800. Drainage attempted, but very little bile secured. Pain increased and required two $\frac{1}{4}$ gr. hypos of morphine to relieve. This relaxed him and continuous drainage begun and continued for eighteen hours, and 3600 cc mixed bile recovered. Simply ran out, filling bottle after bottle. At first strings and plugs of mucus and slime, with microscopical fields of pus, inflammatory débris, shadow cells, bacterial colonies. Culture: B. coli only. At the end of two days rigid abdomen relaxed, temperature dropped to normal, leukocytes to 6,000. Returned home on fourth day to continue home drainage, use of colon vaccine and report in two months.

Comment. This case, while in no way a brilliant success, illustrates what may now be done as a temporary corrective measure, if not a life saving measure, upon a patient with toxic hepatitis, hepatic cirrhosis and acute cholangitis, for whom surgery has accomplished its utmost. Many might say that another choledochostomy would be indicated. If drainage, however, is the desirable result to achieve, I believe it can be accomplished better in a case of this sort by draining by way of the duodenum than through the abdominal wall. Contrast the amount of duct drainage in the choledochostomy of 1921, averaging 24 ounces or 720 cc in twenty-four hours, with the 3600 cc drained in eighteen hours by continuous non-surgical biliary-tract drainage, thereby avoiding the operative shock resulting from exposing the common duct through a mass of adhesions. Furthermore, it would be difficult for a surgeon to do *more* in a case of this sort than to drain the common duct, and thereby the liver, where probably the greater amount of his residual infection lies. It is quite astonishing that as much bile as this should be delivered from a liver operatively and clinically considered to be cirrhotic.

(Case No. 1159).—Mrs. C. T., aged sixty years, referred to Dr. Bartle and me April 28, 1921.

Chief Complaint. Complaining of jaundice, gradually deepening for two years, itching skin. Recurring chills and fever. Vomiting spells. Attacks of violent epigastric pain.

Family History. Two brothers have had renal calculi; 1 dead, 1 recovered.

Past History. Recurrent tonsillitis; influenza; left otitis media, with discharging ear for three weeks in 1917. Jaundice of a catarrhal type in 1913 for six weeks; again in 1918 for several months, and since 1919 has been continuous.

Operations:

1900. (a) Uterine curettage for menorrhagia.

(b) Shortening of round ligaments for uterine prolapse.

1901. Double suspension of kidneys.

1912. Appendectomy.

1915. (April). Cholecystectomy.

(June). T-tube inserted.

(December). Choledochostomy.

Present Illness. From childhood subject to ear-sickness. Has been unable to eat as others did on account of vomiting, which stopped after her kidney fixations in 1901, and she remained in fair health for ten years. Then for one year had a "chronic appendix," removed in 1912, and was again relieved for two years. Gall-bladder pains began before the appendix was removed and grew

worse during 1914, and violent colic attacks ("hundreds of them") resulted in operation in April, 1915, when gall-bladder was found to be much inflamed and containing stones. Six weeks later a T-tube was inserted in the common and hepatic ducts, but jaundice continued as drainage was poor, and eight months later (December, 1915) a rubber tube was inserted and sewn into the hepatic duct and into the duodenum and covered over with omentum. Jaundice promptly cleared up and was well for one year, when pain attacks recurred in upper right quadrant. Since 1918 has had intermittent jaundice, chills and fever, with continuous jaundice for two years.

Physical Examination. Very weak, generally prostrated, but cardiac function still good. Pulse 80, blood-pressure 120/84. Green-bronze jaundice.

Abdomen: Diffuse tenderness, but most sensitive in left epigastrium and hypochondrium, considered to be pancreatic.

Kidneys: Albumin +, indicanuria ++.

Blood: Hemoglobin 72; white blood cells, 9,040.

Fractional Analysis: Anacid gastritis with fasting and digesting biliary regurgitation and traces of occult bleeding in all fractions.

Biliary-tract Drainage: Delayed entrance time to forty minutes. Very slow recovery of bile, to the extent of 60 cc, which was creamy yellow with foul odor and microscopically was pure pus, with many masses of bile pigment and a swarming bacterial flora in colonies. The cultural growth of *B. coli* occurred in two hours at room temperature. Many dark reddish masses the size of a pin head and a few the size of a grain of sand, when microscopically studied are made up of masses of bile pigment.

Treatment. Sodium salicylate; caroid; bile salts. *B. coli* vaccine. Intermittent drainage. The colon bacillus vaccine gave marked local, general and focalizing reactions, increasing the jaundice for twenty-four hours, and producing chills, fever, malaise. Drainages were frequently followed by acute exacerbations in pain, which gradually lessened. Pus and acute inflammatory debris with mucopus flocculations were constantly recovered. She was prevailed upon to enter a rest home and take continuous drainage for three weeks in April, 1922, under Dr. Bartle's direction. At this period it appeared that her life could not be saved. The treatment was persisted in with very little coöperative effort on the part of the patient, and a sufficient improvement was secured to permit her to be up and about, and resume her occupation as housekeeper and manager of a small apartment house.

Follow-up Note. February 9, 1923. Physically much improved. Stamina raised. Does a full day's work, but is harassed by many home worries and burdens. No longer notes old car-sickness. Occasionally gives herself a drainage, but is always prostrated following

it for six or eight hours, and then picks up again. Bile still shows many pus cells. Always difficult to get duodenal tip into duodenum at the proper drainage point (adhesions?). But following her three weeks' period of continuous drainage her jaundice cleared within six weeks and she has *remained jaundice-free since that time*, and has had no further attacks of pain, or chills, fever or sweats.

Comment. Continuous medical drainage of the biliary tract undoubtedly saved the life of this patient at a time when her recovery was despaired of, and has permitted her to live in relatively greater comfort for nearly a year and to resume her livelihood, where before she was a complete invalid. In this case surgery has probably accomplished all that was surgically possible, since her gall-tract operations were done by Deaver, a master surgeon of the upper right quadrant. I believe, too, that, had this woman's economic status been better, more might have been accomplished, for she had invested all of her savings in her apartment house, and felt that it was absolutely necessary for her to get back to its supervision at a time when she was really not well enough to do so.

We were very much interested in seeing what could be done for this poor woman, and now feel repaid in seeing her relatively improved state of health. Certainly her common duct obstruction has been relieved, the intense purulent inflammation has subsided to a notable degree, and her continued absence of jaundice and acute cholangitis over a period of seven months indicates that her common duct still remains unobstructed and the acute process can now be controlled by intermittent drainage conducted by herself.

Report of Case XVIII.—Illustrates a case of acute empyema of the gall-bladder successfully aborted by non-surgical drainage in a patient for whom surgery was strongly urged, but refused by the patient.

Mr. T. C. W., aged forty-three years, presented himself at 9 P.M. on May 9, 1920. He had been taken with acute upper right quadrant pain with fever and sweating the night before and had driven 200 miles by motor that day. He was given an immediate drainage and 170 cc very turbid, dirty brown "B" fraction was secured, containing a tremendous amount of mucus and mucopus masses, and the final 40 cc recovered was thick creamy pus, with foul stench and loaded with cocci, which culturally grew out of a hemolytic streptococcus.

Physical examination of his abdomen presented the characteristic picture of acute surgical upper right quadrant, extreme rigidity and exquisite tenderness. Leukocytes 37,000.

He was sent home to bed with ice bag, liquid diet, hexamethyl-

amine gr. v, every four hours. When seen the next morning the change in the physical examination was startling. No rigidity of upper right quadrant, very slight tenderness on deep palpation, and all of the evidence of an acute empyema had subsided. His temperature was 98, leukocytes 11,000. Notwithstanding this improvement, operation was urged as the only possible measure for his consideration. On account of important business necessities, which meant a matter of financial ruin for him if he were confined to bed for necessary surgery within the next three weeks, he declined to follow this advice, and against my better judgment I agreed to see what could be done.

He was drained again on May 11, 12, 13, 15, 18, and 25, with continued improvement in subjective and objective findings, which permitted him during this period to meet his business engagements for a part of each day. A streptococcus vaccine was prepared and begun.

On June 2, he disappeared, and I did not see him again until April 1922, nearly two years later, when he came in and stated that he had gotten along nicely during this period, with no flare-backs, but examination of his abdomen by tuning fork suggested the presence of upper right quadrant adhesions. Further investigation was suggested and the advisability of operation reopened, but was again declined.

Comment. This case is worthy of mention only for the reason of illustrating that even an acute empyema can sometimes be made to respond to medical drainage where the exigencies of the case demand. In this instance I consider this patient was unwise in not permitting a surgical correction to be undertaken, for he was an acceptable operative risk, and on these grounds medical drainage could not be considered justifiable. On the other hand, where this state of empyema of the gall-bladder exists in an enfeebled, poor surgical-risk patient, a preliminary attempt at medical drainage of the tract may so tide over the acute picture as to permit the patient to be built up to a point where surgery can be more safely practised. If the gall-bladder cannot be made to deliver its purulent content, then medical drainage is out of the question and surgery must be resorted to.

CHAPTER XXXI.

REPORTS OF CASES.—(CONTINUED.)

Reports of Cases XIX and XX.—Illustrate the effectiveness of non-surgical drainage, coupled with general medical management, in elderly, poor surgical-risk patients, presenting symptoms and findings of gall-tract disease, with high grade toxemia and multiple complications, involving several vital organs (myocarditis, nephritis, hepatic cirrhosis).

(Case No. 1079).—Mrs. C. D., aged fifty-nine years, was referred November 9, 1920.

Chief Complaint. Complaining of severe prostrating attacks of headache with morning nausea and intermittent attacks of upper right quadrant pain, referred around costal margin to shoulder blade. Duration twelve years plus.

Past History. Recurrent tonsillitis. Rheumatic fever, twice. Two nervous breakdowns requiring sanitarium treatment.

She has been addicted to the use of phenacetin and other coal tar remedies for many years for the relief of constant headache and shows evidence of chronic drug poisoning. Her last bed illness was in August, 1920, with inflammation of liver and kidneys, at which time she had considerable edema.

Operations. Fistula-in-ano twice thirty years ago, with repair of rectal ulcer in 1916.

Present Illness. Dates back for over twelve years, during which period she has had attacks of what appeared to be biliary migraine, accompanied by morning nausea, which she could relieve and sometimes abort by washing out her stomach, which has been a daily habit with her for many years. By removing bile from her stomach, she secured her best relief. Constipation-laxative habit for over twenty-five years. No natural bowel movement. Has taken a physic nearly every night. Occasional colonic irrigation has temporarily helped her.

More recently has had attacks of upper right quadrant pain and a dull aching sense of fulness under the right costal margin, at times radiating around rib border to centralize in dull ache at right shoulder blade. Has been advised several times to have her gall-bladder removed, but each time she was considered an unwarranted surgical risk,

Physical Examination. Extremely toxic, greatly prostrated, under-nourished woman, with intense skin jaundice and chronic swarthinness; lips cyanosed. Temperature 96.2° F.; weight 106 pounds, a loss of 9 pounds over her best weight; height 5 feet 1½ inches. Palate and sclerae brightly jaundiced. Well marked arcus senilis.

Tongue: Brownish-black with a blue coating, unlike anything I have seen (cyanosis?, chronic drug poisoning?).

Gums and teeth negative. Tonsils atrophic, clean. Lungs negative except moderate emphysema.

Heart: Much enlarged, action markedly irregular, skipped beats, reduplicated second sounds, occasional extra systoles. Sounds lacking in muscular tone. No murmurs. Pulse 80 to 120; blood-pressure 156/82; pulse-pressure 74.

Abdomen: Visceroptotic type; pulsating uncovered aorta; suggestion by tuning fork of adhesions in upper right quadrant. Moderate tenderness over gall-bladder point without rigidity or spasm. Liver small; stomach and colon dilated.

Extremities: Edema of feet and ankles.

Laboratory Examinations. Blood: Hemoglobin 70 per cent; red blood cells 3,140,000; white blood cells 4,800; polymorphonuclears 46 per cent; transitionals 4 per cent; large mononuclears 2 per cent; lymphocytes 48 per cent. No alterations in red blood cells.

Blood Chemistry: Urea 15 mg. per 100 cc blood. Blood sugar 0.09 per cent.

Urinalyses: Tendency to fixation of specific gravity. Trace to light cloud of albumin. Indican ++; diacetic acid trace. Tube casts; white blood cells +2; 'phthalein 40 per cent.

Stools: Mushy, sour to pungent odor; light clay-yellow; mucus +2; occult blood, 0. Neutral fat, fatty acid crystals, muscle fibers, partly striated.

Gastric Analysis. Fasting and digesting biliary regurgitation. Microscopy showing duodenal and biliary tract exfoliated epithelium and bile-stained colonies of bacilli. Fractional analysis shows typical extra-gastric curve, rising to free HCl 40, total acidity 80 at one hundred and twenty minutes. Occult blood +1 to +2 in all fractions. Surprisingly little mucus.

Biliary-tract Drainage (Diagnostic). Delayed entrance time. Oddi's sphincter relaxed without stimulation. "A" fraction not dependable. "B" fraction inky black, opaque bile, showing a reddish-brown color when thin enough to transmit light. Three and a half ounces discharge intermittently. Microscopy showing several large masses of cellular tissue suggesting the architectural arrangement of liver cells (see Fig. 115, page 326); many masses of bile pigments and cholesterin crystals, quite perceptible to the touch;

colonies of bile stained cocci and bacilli. "C" fraction negative, except for increased viscosity and a deeper golden-yellow than normal. Drainage sluggish. Culture: *B. coli* and coccus apparently belonging to staphylococcic group, but atypical pigment.

Diagnosis. Major: Pronounced hepatic intestinal toxemia. Cardiac hypertrophy with myocarditis, advanced and decompensated. Interstitial nephritis, secondary to cardiovascular disease.

Collateral: Low grade cholecystodochitis with infection. Atonic gall-bladder with static bile. Biliary migraine; possible cholelithiasis; duodenitis; pancreatic insufficiency; chronic drug poisoning (coal tar); chronic constipation.

Comment. This case was considered to be a bad risk from every angle. Operative interference was distinctly contraindicated and it was considered doubtful as to whether the patient was strong enough to permit any topical measures to be carried out.

Treatment. Hospitalization nine weeks. Biliary-tract drainage. Autogenous vaccine therapy; pancrobilin; senna agar fruit paste; cardiac supportive therapy; diuretics; restrict fats and proteins; bed rest; breathing exercise; hygiene.

Continuous biliary-tract drainage was attempted, but after three days of this the patient developed an acute acidosis and the tube was withdrawn and food was forced, together with proctolysis with 10 per cent sodium bicarbonate and 5 per cent glucose. At this time the technic for continual biliary drainage as outlined on page 462 had not been perfected as regards the regularity of feeding every two hours, and this patient taught me a lesson to be on guard for premonitory symptoms of a starvation (?) acidosis, which can best be detected by daily urinary examinations. Her recovery from the symptoms of acidosis was prompt, and drainage was then done every other day for two weeks, and then every third or fourth day to a total of twenty.

During this time it was surprising to see the change that took place in the patient. The jaundice gradually faded out, the heart regained its tone, the violent headaches ceased almost at once, and the morning nausea gradually subsided. The mentality of the patient cleared and she became bright and animated, whereas before she was listless and in a state of constant mental hebetude. But the change in the type of bile that was drained from the gall-bladder and liver was most interesting. From inky-black it changed to dark brown, then to a deep golden-brown, and finally a golden-yellow, and flowed freely and promptly without the necessity of repeated stimulation.

Vaccine injections, even with minimal doses, gave rise to severe localized, general and gall-tract focalizing reactions. No other treatment for her constipation was used, with steadily improving

function. At the end of her first month there was marked improvement in the cardio-renal features, which improved more rapidly thereafter. It was quite astonishing to see the stabilization of her heart to increasing effort and sudden shock (husband fainting by her bedside, etc.), by the time she left the hospital.

Progress of Case. This patient went to Atlantic City with her nurse to continue her drainages and for a period of recuperation, where she remained until April, 1921, when she returned for a check-up drainage. She walked in briskly and showed greatly increased endurance, presenting symptoms all gone, no headache for three months, marked stabilization of cardiac mechanism. Pulse 64, even, regular, good tone and volume. No skipped beats, heart sounds clear, good quality. Blood-pressure 116/78, pulse-pressure 38. Color greatly improved. No jaundice of scleræ or palate. Tongue normal in appearance. Bile grossly normal. "B" fraction golden-yellow, clear, transparent, no floccules. Microscopy entirely negative. Has been on drainage schedule every sixth day for past three months and now to extend drainage time to ten days. She then went to California and continued intermittent drainages for some months and wrote regularly, reporting steady improvement.

In September, 1922, she developed a severe pyonephrosis of the right kidney, from which she recovered in December, 1922, without any conspicuous flare-backs in her former gall tract, digestive or cardiovascular pictures.

Early in January, 1923, she fell and broke her right hip, from the effects of which she was expected to succumb. But on February 27, 1923, I received the following letter from Dr. Martin J. Synnott, of Montclair, N. J., who was in direct charge of her case at this time. He writes:

"Mrs. D.'s condition at the present time is quite satisfactory. After several weeks in the hospital with her right leg and hip demobilized in plaster-of-Paris her condition deteriorated as a result of toxemia. She developed a low muttering delirium and the outlook seemed very bad.

"I am glad to report, however, that after a biliary-tract drainage, which was given her successfully, but with considerable difficulty as you may imagine, her condition immediately improved. The drainages have been kept up at intervals of one week, and she is now home and in fine shape,

"I am convinced that she owes her life to the efficacy of duodenobiliary-tract drainage. It was the most remarkable thing I have ever seen, the way her mental condition cleared up after a successful treatment."

Comment. It has seemed to me quite extraordinary, as I have reviewed this patient's case, that she could have been so strikingly

improved as a result of drainage of her gall-tract, together with transduodenal lavage, and the use of vaccines. The other factors of general management concerned in her case were no different than those so commonly employed, and I do not believe that her improvement has been so much the result of the general measures of management as the extraordinarily beneficial effect of the direct drainage of her liver and gall-tract and the flushing out of her intestines, which served to detoxicate her and take a severe carrying load off her heart, kidneys and liver. From every angle, on her first presentation, she was an exceedingly bad risk patient, with a prognosis none too bright.

(Case No. 1014).—Miss B. M., aged sixty-six years, first seen July 27, 1920, referred by Dr. S. J. Meltzer, New York City.

Family History. Parents long lived, dying at ages of eighty-four and ninety-seven. Three brothers showed tendency to gastrointestinal disease, dying respectively of intestinal gripe, cirrhosis of the liver and catarrh of the stomach.

Past History. Typhoid fever at ten years; pneumonia at twenty-six years; gastritis at fifty-one years. Recurrent attacks of jaundice. Oral sepsis leading up to the extraction of all teeth, and has worn double plates for years. Subject to bilious attacks with terminal vomiting for many years. Notwithstanding this she considers her health as robust until January, 1920.

Present Illness. Starting about eight months ago developed lassitude, anorexia, loss of concentration, increased tendency to constipation, headaches, with tendency to intermittent jaundice lasting a few days. Five months ago began to develop attacks of epigastric pain, referred to the angle of the left scapula which tended to recur on an average of every three weeks, lasting from three to six hours, gradually wearing off and leaving her feeling "mean" for two days. Each attack comes on gradually in afternoon or evening and is gripping, cramp-like, sometimes stabbing central epigastric pain radiating to left scapula. Two hours from the beginning of the attack the pain is at its worst and lasts two to four hours more. She may vomit involuntarily, but not with every attack.

Jaundice, white stools, itching skin and bile-stained urine soon follow. No tenderness; no chills or sweats, no belching; very marked prostration. With each attack the residual jaundice has cleared less and less, until in recent ones the jaundice has been of the green-bronze type. Loss of weight 25 pounds in eight months.

Roentgen rays recently taken in New York were positive for gall stones.

Physical Examination. This patient was visibly very ill, so weak that she had great difficulty in standing alone unsupported. Pronounced jaundice of scleræ and palate, and the skin was green-bronzed, dry and pigmented.

Temperature 98°; pulse 100; respiration 18; blood-pressure 145/85.

Superficial arteries, no increased sclerosis for age. Tongue heavily coated, smooth. Thorax, abdomen and extremities show marked loss of tissue.

Lungs: Hyperresonant, emphysematous.

Heart: Myocarditis, advanced; toxic?

Abdomen: From xyphoid and spreading across from epigastrium and hypochondriæ there were several score brownish pigmented papules (warts?). Diffuse sense of resistance in upper abdomen, particularly right quadrant below the hard edge of a definitely enlarged liver. No tenderness; gall-bladder not palpable; tuning fork test for adhesions positive from stomach through liver.

Laboratory and Technical Examinations. *Biliary-tract Drainage:* July 28, 1920. Four hours after breakfast of cooked cereal, tea, bread and butter, no residuum extractable. Test lavage proved no residuum, mucus + with flocculi in first two glasses only.

Tube entered duodenum in ten minutes. Common duct closed. Mucoid brown-red flecked fluid from duodenum, with heavy shaggy flocculi, unbile stained. *Microscopical.* Much duodenal epithelium, many neutral fats, occult blood +.

After first stimulation with 75 cc magnesium sulphate 33 per cent, yellow bile-stained mucus plugs slowly appeared. After two further stimulations duct was nicely opened and 75 cc of light golden-yellow, very viscid, tenacious bile, with quantities of mucopus flocculi. No "B" fraction and very scanty "C" fraction. *Microscopical.* Bile-stained flocculi show heavily massed cuboidal and short columnar epithelium. Large quantities of heavily granulated crystals appearing as crescents. Pus cells +2; red blood cells +1; inflammatory debris and increased bacterial flora, bile-stained bacilli.

Bacteriology: *B. coli communior.*

Blood: Hemoglobin 72 per cent (Dare); red blood cells 3,900,000; white blood cells 5,600; polymorphonuclears 60 per cent; transactionals 5 per cent; large mononuclears 3 per cent; lymphocytes 32 per cent.

Stool: Hard, dry, scybalous, gray-white, mucus adherent. Occult blood trace. *Microscopical:* Fatty acid crystals +3, soaps +3, unstriated muscle fiber and striated muscle fiber +2, starch, cellulose and vegetable remnants +2. Bacteria: Gram-positive 4/10, Gram-negative 6/10.

Urinalysis: Normal findings in both A.M. and P.M. specimens

except for indican +2. Functional test to phthalein: 430 cc excretion and 75 per cent drug elimination in three hours.

Gastric Analysis. July 30, 1920. Twelve-hour fasting stomach residuum; no retention, 30 cc golden-yellow, mucoid. Free HCl 0, total acidity 25. Occult blood 0.

Digesting stomach: Slow hormonal response. No free HCl, total acidity 25 at thirty minutes. Then gradually ascending to high point at ninety minutes of 42.5 and 70. Biliary regurgitation in all specimens. Increase of mucus in the six terminal extractions. Gross regurgitant bile in all specimens.

Microscopical. Inflammatory evidence regurgitant from duodenum and gall tract; bile-stained mucus, pus cells, exfoliated duodenal epithelium, bile-stained short bacilli.

Gastric motility normal.

Comment. This fractional analysis was somewhat of a surprise in showing such well marked secretory response in view of the preceding oral sepsis, gastritis and later developments, and achylia might well have been suspected, particularly since the patient states that she craves tomatoes, acids and loves lemon juice. This merely illustrates how frequently unsafe it is to "guess" the state of gastric chemistry and emphasizes the need of testing out each patient. Note that two days after the first biliary tract drainage the common duct remains patulous, and on account of the duodenitis is regurgitating bile into the fasting and digesting stomach.

Provisional Diagnosis. Provisional diagnosis based on history and physical examination suggested the possibility of cancer of the head of the pancreas, cirrhosis of the liver, and a presumptive cholelithiasis. A poor prognosis was offered on account of the extreme toxic state and feebleness and badly damaged myocardium of the patient. The possibility of pancreatic cancer immediately became less likely in view of the promptness with which the biliary obstruction was relieved after one drainage. This would hardly have been the case had the obstruction been due to the pressure from new growth.

Treatment. Operation was not advised and management by non-surgical drainage, together with the use of tonics, mineral oil, pancreatic and hepatic substitutive products and autogenous vaccines of *B. coli*, were offered as a palliative measure only.

Progress of Case. Non-surgical drainage of the gall tract, each followed by transduodenal lavage and enema, was given six times during the month of August, 1920, and on September 11 and October 2. Each successive drainage secured more and more liver bile. During this period there had been steady and startling improvement. The jaundice cleared, bowel movements occurred daily and were no longer hard, dry and scybalous, but a semi-soft dark yellow-brown

stool. Appetite and strength greatly improved and heart action excellent.

She was then referred to Dr. George Roe Lockwood of New York City, who carried out several additional drainages with continued improvement. So far as I know this was the extent of her drainages.

A follow-up letter received on November 22, 1922, twenty-seven months later, states that Miss M. has had no return of any attacks of pain. She has gained 20 pounds in weight. Her jaundice has never recurred, and her general health is excellent.

Discussion. The satisfactory and steady progress that this patient made was a surprise to me, for I felt that her prognosis was extremely grave. It would seem that the measures adopted for her as an alternative measure to surgery, in a patient presenting as a poor operative risk, very nicely proved the palliative usefulness of non-surgical biliary tract drainage, which brought about a relative cure.

Report of Cases XXI.—Illustrates disseminated infection of the gastro-intestinal tract and severe hepatic intestinal toxemia in a very asthenic visceroptotic, and a plan of management which can be highly recommended because of its success in many similar cases. Long continued treatment must be carried out in order to secure the maximum results.

(Case No. 1286).—Mrs. A. L., aged forty-eight years, was referred on February 27, 1922.

Chief Complaint. Complaining of severe cramp-like pain in epigastrium occurring fifteen minutes after eating, lasting one to two hours. Duration more than one year, extremely severe for past two weeks. Weakness, loss of weight.

Family History. Mother died of uterine cancer at sixty-eight years. One brother died of pulmonary tuberculosis at twenty-three years and another of typhoid pneumonia at thirty-one years. Otherwise negative.

Past Medical History. Erysipelas during infancy. Typhoid fever twice, at nine and twenty-six years of age. Very ill with the second attack for four months. Heat prostration in 1913 with six weeks' slow convalescence, and since then has been delicate. Moderately severe attack of pandemic influenza in 1918.

Present Illness. For one year she has been steadily growing weaker and gradually losing weight to a total of 44 pounds in twelve months. With this loss of weight there has been a steady increase in postmeal epigastric distress after both solid and liquid foods, together with periodic acute attacks of severe, cramp like, general abdominal pain with marked flatulency. Abdominal pressure

increases the pain. For the past two weeks has been given nearly daily injections of morphine to control it. Abscessed tooth extracted two years ago. Two months ago she had her appendix, both ovaries and her uterus removed, the latter on account of fibroid degeneration. At this operation the stomach and gall-bladder were stated to be normal.

Physical Examination. Brought in as a litter case. She was alarmingly weak, weight 94 pounds. Temperature 99° F.; pulse 140; respiration 20; blood-pressure 165/115 (superficial arteries sclerotic). Skin very sallow; breath foul; postnasal mucus; gums inflamed, puffy and retracted, and numerous aphthæ. Scleræ and palate definitely jaundiced. Reflexes markedly exaggerated. Lungs negative, but heart beats heard everywhere throughout anterior and posterior thorax. At apex, sounds are clear and very forcible.

Abdomen: Extreme type of congenital visceroptosis with usual stigmata. General abdominal resistance more marked in upper half.

Recto-sigmoid: Mucus membrane thickened; granular areas; hemochromatosis; sigmoid tortuous, spastic, containing fluid with slimy, bubbling feces.

Laboratory Examinations. Blood: Hemoglobin 84 per cent; white blood cells 8,720; polymorphonuclears 70 per cent; transitionals 4 per cent; large mononuclears 7 per cent; lymphocytes 19 per cent. Wassermann negative.

Kidneys: Low specific gravity: 1.004, 1.005, 1.006. Faint trace, to trace of albumin; indican excess. Hyaline casts. 'Phthalein 46 per cent.

Stool: Findings suggest enterocolitis.

Stomach and Duodenum: Normal except for mild catarrh.

Biliary Drainage: Infective exfoliative cholecystodochitis, with cultural recovery of staphylococcus aureus and B. coli from "B" and "C" biles. "B" fraction static, black-brown, viscid. No suggestion of calculus.

Hepatic Functional Test: Shows deficient elimination.

Roentgen-ray Examination. No evidence of gall stones. Gall-bladder not visualized. The liver is quite small. Gastrocoloptosis. Possible diverticulum in descending portion of duodenum.

Diagnosis: Major. Pronounced visceroptosis. Disseminated infection of gastro-intestinal tract (gums, gall tract, enterocolon). Hepatic intestinal toxemia. Beginning hepatic cirrhosis?

Collateral. Doubtful kidneys. Arteriosclerosis. Abdominal angina?

Treatment. Visceroptotic rest cure management six weeks, with elevation of foot of bed; Curtis abdominal pad; bromides; forced

feeding, largely carbohydrates, cereals, milk, restriction in animal protein and excess fat; topical care of gums.

Oral medication: Bromides, belladonna, taka-diastase; later, iron and manganese, compound hypophosphites and *Bacillus acidophilus* milk.

Progress. After two months of such management marked initial improvement had begun. Pain free, distress lessening, digestive functions improving, although absolutely no gain in weight.

On May 24, she was considered well enough to begin therapeutic biliary-tract drainage followed by transduodenal lavage. These were given at weekly intervals for three months, during which period she gained greatly in strength, $8\frac{1}{2}$ pounds in weight and noticeable lessening in the toxic factors. The drainage intervals were then lengthened out to every fourteen to twenty-one days, with progressive improvement and a gain in weight averaging 5 pounds a month. On her last drainage on February 6, 1923, when these notes were written, her improvement is really startling. Her skin is clear, complexion good, strength and endurance excellent, drainage findings normal, weight 132 pounds, a total gain of 38 pounds. She has now reached the point where reconstructive graduated exercises can be applied for the purpose of retoning muscle to a point where she can discard the use of her Curtis pad. (See Chapter XXV, Section VII, page 483.)

CHAPTER XXXII.

REPORTS OF CASES.—(CONTINUED.)

Report of Case XXII.—Illustrates a case of acute cholangitis complicating a chronic cholecystitis of several years' duration, presenting an acute surgical abdomen. Attack safely aborted by non-surgical drainage and vaccines and patient prepared for operation at a more favorable time, when the operative risk is reduced to a minimum. Can severe colic simulating that produced by calculi be caused by intra-duct spasm?

(Case No. 1222).—Dr. R. A. L., aged twenty-eight years, first seen October 1, 1921.

Chief Complaint. See present illness.

Family History. Mother had gall stones four years ago at age of fifty-eight. Otherwise negative.

Past History. The usual diseases of childhood. Typhoid fever at age of ten years; recurrent chronic appendicitis, 1909-1912; recurrent tonsillitis.

Operative History: 1912 appendectomy; 1917 tonsillectomy; 1919 right frontal sinus opened and "internasal drainage" for chronic sinus disease.

Recent and Present History. Early in 1919 was kicked in abdomen by demented patient. Received fractured rib (right side) and some internal trauma in region of gall-bladder. Confined to bed for three weeks. Symptoms manifested were severe pain, vomiting with some blood, rigidity in upper right quadrant. An acute injury. This attack subsided.

Was in the best of health until following July, 1919, when acute attack of sinusitis occurred and frontal sinus was opened and drained.

He then enjoyed the best of health until February, 1920, at which time he had some gas distention, with pain and tenderness around gall-bladder, increasing in severity for four to six hours, and then subsiding within twenty-four hours. No residual soreness or tenderness, although some upper right quadrant rigidity and tenderness during the attack.

Then free of all symptoms until February, 1921, when he again had a similar attack. Roentgen-ray studies showed pyloric

end of stomach adherent to gall-bladder. Gall stones negative. Adhesions around seat of old appendix operation. Was advised to have abdomen opened, but since this attack was similar to, and cleared up like the former one, and being free of all symptoms, he decided not to have this done, and continued in the best of health, gaining several pounds in weight during the summer of 1921.

Present Illness. Two weeks ago, without apparent cause and while in the best of health, and sitting quietly in his office reading, the doctor was taken with severe sudden pain radiating across both sides of the diaphragm around precordial region and extending up into the neck and right shoulder. The pain was so severe, and of a vise-like nature, that he was unable to move or breathe. However, ordered a nurse to give him a dram of benzyl benzoate. After two or three minutes symptoms were relieved. Went to his room to lie down, and immediately symptoms returned, but subsided gradually after ten or fifteen minutes, and were followed by a nervous chill. During this attack he had cold clammy skin and beads of perspiration on forehead and forearms. Nervous throughout the rest of the morning, but pain-free. Two hours later, however, the acute symptoms recurred, lasting just a few moments.

Immediately following onset of the pain became numb in both feet and legs, both forearms and hands, the fingers being contracted with thumbs strongly flexed, cutting into palms of hands. This condition lasted for thirty minutes, during which time he was unable to separate his fingers or move his thumbs. Throughout this time he had severe pains through hands and in calves of legs and also had the sensation that the muscles of the face and neck were contracting, and when he attempted to take a dose of benzyl benzoate he was unable to swallow. During this numb period he was free of pains in the chest.

After about thirty minutes all symptoms subsided and for the next two to three hours he was again pain-free. Then he began to notice pain, tenderness and rigidity around gall-bladder region. This continued for about forty-eight hours, although he went about his hospital duties. However, he has had pain, tenderness and rigidity ever since, although he has been free of nausea and vomiting or any reflex pains in the chest. Following the two previous attacks he had no pain, rigidity or tenderness. There was no febrile reaction, although his leukocyte count was 11,000.

Physical Examination. No jaundice except of scleræ. Temperature, 99.2° F.; pulse, 90; respiration, 20.

Abdomen: Surgical upper right quadrant. Exquisitely tender and board-like rigidity to right rectus. Tuning fork test for adhesions doubtful through liver, but double plus to costal margin.

Laboratory Examinations. Leukocyte count 11,200. Polymorphonuclears 84 per cent; transitionals 3 per cent; large mononuclears 5 per cent; lymphocytes 8 per cent.

Immediate Biliary-tract Drainage. Fasting residuum 30 cc egg yolk yellow. Free HCl 65, total acidity 85. Occult blood trace. Microscopical: Mucus +3; oral epithelium +1; gastric +2; digested white blood cells +2.

Delayed entrance time to forty minutes. Duct closed, but relaxed to first magnesium sulphate stimulation and 30 cc of viscid, turbid, stringy "A" fraction recovered with flocculi +3. Three stimulations given and only 35 cc light golden-yellow "C" fraction recovered but many mucopus flocculi. No "B" fraction. Microscopy of "A" and "C" flocculi; bile-stained pus cells +2; bile-stained "shadow cells" and semi-necrotic low columnar epithelium; much heavy, dense, twisted, spiralled mucus, encrusted over with bile salts, and pools and lakes of oleaginous material taking Sudan III stain; pus cells +3; bacteria +3. Bacteriology: Pure culture hemolytic streptococcus.

In view of the acute condition it was considered wiser to have the doctor return to Baltimore to his hospital for bed rest, liquid diet, ice-bag. Sodium salicylate gr. xx every three hours; hexamethylenamine gr. v, t. i. d.; benzyl benzoate p. r. n., and to return for further study after the acute process had subsided.

October 11, 1921. Dr. L. returned today, having followed out the instructions in regard to bed rest, diet, and medication, and the physical findings showed an absence of the upper right quadrant surgical abdomen, although there was definite tenderness at the gall-bladder point with some stiffening and spasm of the upper right rectus muscle. The leukocyte count had, however, dropped to 5920 with a differential as follows: Polymorphonuclears 58 per cent; transitionals 4 per cent; large mononuclears 6 per cent; lymphocytes 31 per cent; basophiles 1 per cent.

He was given three office drainages on October 11, 13, and 15. All of these drainages recovered the hemolytic streptococcus in pure culture, with microscopical findings of pus, catarrhal exfoliated gall-tract epithelium, but no crystals, a lessening in mucus and a gradual unblocking of the cystic duct, so that on October 15 a definite reddish-brown "B" fraction was recovered.

Diagnosis. Question of stones *sub judice*, but doubtful. Adhesions between duodenum and gall tract most likely, together with acute spasm. Acute cholangitis, possibly cholecystitis. Cystic duct obstruction subsiding.

Treatment. Following these three drainages Dr. L. had very complete symptomatic relief. Operation discussed, but non-surgical drainage, oral medication, vaccines and diet suggested for three to

six months as either a preliminary to surgery, or, if successful, no surgery.

The oral medication consisted of *Pilulæ pancrobilin* plain, 1 one hour p. c.; *pulvis antacid* (see page 476) $\frac{1}{4}$ teaspoonful at thirty, sixty and ninety minutes p. c.; *tincture belladonna* in ascending doses to physiological effect a. c. for two or three weeks and then stop.

A vaccine of hemolytic streptococcus made up to a dosage that 1 cc = 1,000,000,000 bacteria, with injections every fifth day (see page 463).

Dr. L. agreed to carry out this plan and went to Baltimore and placed himself under Dr. Friedenwald's care for non-surgical drainage.

On January 16, 1922, Dr. L. reported back for check-up, having had twelve drainages under Dr. Friedenwald's supervision, and the recent cultures had all been negative for the hemolytic streptococcus. Dr. L. says he has been feeling finely, has gained about 5 pounds, appetite good, sleeps well, bowels regular. Has had no definite pain since October, but at times has indefinite dragging sensation, which he attributes to adhesions.

Recheck drainage here found conditions very greatly improved, cystic duct unblocked, gall-bladder emptying well, and no longer static, but objective findings still gave evidence of catarrh and infection, and a culture again recovered pure hemolytic streptococcus.

Roentgen Ray. At this time Dr. Manges studied his case by roentgen ray and reports as follows:

"In the case of Dr. R. A. L., I beg to report that I can find no definite evidence of gall stones. The gall-bladder itself is not visualized, and I have been unable to determine the presence of any adhesions to the duodenum.

"The duodenal tube was apparently in its proper position at our first examination. There is a perfectly smooth curve from the pylorus into the descending duodenum. This duodenal curve is also very nicely shown by the small quantity of barium and water given Dr. L. at our second observation, and both these points are nicely demonstrated on the films.

"I was impressed with the marked rapidity with which the stomach expelled the barium and water. You will see that the duodenum and jejunum are well distended. I can't express any opinion as to the significance of this rapid emptying, for the mixture was merely barium and water and the observation was of only short duration.

W. F. MANGES."

Dr. L. was urged to continue on with his drainages and use of vaccine until the objective findings cleared up.

On June 5, 1922, he reports that he has been feeling splendidly well, absolutely no symptoms. Rides horseback, plays golf and tennis without causing any soreness in gall-bladder region. No medication for months, no drainages for over a month, and all

recent drainages by Dr. Friedenwald have shown biles clear of flocculi.

January 17, 1923. No drainages for eight and a half months. No medication. Dr. L. has remained perfectly well, absolutely symptom-free, doing everything, taking rather violent exercise without any abdominal distress of any kind. On full diet of all descriptions. Has gained a total of 15 pounds. Dr. L. states that he would consider himself clinically cured.

Drainage findings today are strikingly different from those which previously existed. A normal function of duct; "A" bile clear with no flocculi. As drainage proceeded flocculi to the extent of plus one appeared, with doubtful "B" fraction.

Microscopy of flocculi, however, *still* show mucus +2, exfoliation of bile-stained pus cells +1, a small amount of mixed short and tall columnar epithelium, but neither more than within normal limits. No evidence of crystals. Bacterial flora diffuse, but normal in gross amount. No colonies. Occult blood +1 in "A" and "C" biles.

Bacteriology: "A C" bile sterile (Kolmer). In view of these findings Dr. L. was advised to take a drainage at least once in every three or four weeks so that this residual evidence of inflammation does not accumulate and give rise to one of the acute explosions which previously occurred every year or two years as detailed in his history, or else submit to early operation.

Discussion. I think this case illustrates very forcibly that it is possible to accomplish something very definitely helpful, possibly curative, even in acute surgical gall-tract disease. I do not say that this is good "blanket" treatment to apply to every case. Certainly a very nice judgment is required in regard to the selection of this method as applied to each individual patient. I hoped to be able to abort Dr. L.'s acute condition and to prepare the surgical field and get him in the best of shape before a necessary operation could be done at the most favorable time. This time now seems to have arrived and Dr. L. will shortly be taken up for operation, the results of which will be reported in a later "follow up."

Report of Case XVIII.—Illustrates an acute cholecystodochitis in a bad operative-risk patient, apparently cured by non-surgical drainage and vaccines, as proved a year later by surgical exploration done for an acute intercurrent appendicitis. In this case acute colic, suggesting gall stones, seems to have been produced by intra-duct spasm, increasing intra-duct tension acting on acutely inflamed mucosæ.

(Case No. 1076).—Mrs. X., aged forty-three years, first seen November 3, 1920, referred by Dr. E. J. Porteous.

Complaint. Attacks of upper right quadrant pain, recurring every few weeks, accompanied by nausea and vomiting. Followed by depression. Gradually increasing swarthy of skin.

Family History. Unimportant as bearing on patient's case.

Past History. Scarlet fever at age of twelve years; tonsillitis, doubtful history; neuritis for one month at age of thirty-seven years; influenza (mild) in 1918, but slow convalescence.

Recent and Present History. Had first attack of upper right quadrant pain fourteen years ago, of much milder type than now. Second attack six months later; since then more frequently. Up to one year ago averaged three attacks a year. During past six months attacks have occurred every two to four weeks, with increasing severity, not always requiring morphine. The attacks usually start one to three hours after the evening meal; being preceded by a short period of burning and fermenting distress in stomach and then the pain begins in the upper right abdomen below and along the left edge of the right costal margin; a steady agonizing pain gradually reaching a climax in three to twelve hours, when the agonizing pain suddenly leaves her ("as if something inside gives way") and gradually dies away, and leaves a sore spot in region of gall-bladder for two to three days. The pain is not referred to back, shoulders or elsewhere. Nausea and induced vomiting only during and after pain begins. When she begins to vomit bile she finds that this augurs a prompt, though partial, relief of the acute pain. No jaundice either during the attacks or afterward, but her skin has become progressively more swarthy. Her stools, however, have ranged from yellow-brown to clay colored. No stones ever found in stools after an attack of pain, although often searched for. No belching. Her nervous system was severely shocked in 1918, and she had been under great emotional strain, and *she* notices that her attacks have seemed to be induced by worry, fear or anger.

She has noticed an increasing drowsiness. Wakes unrefreshed after eight to ten hours' sleep, often disturbed by nightmares.

Physical Examination. Looks tired out, toxic, deep brown circles under eyes, and appears melancholic and depressed. Temperature 98° F.; pulse 76 to 90; respiration 18; blood-pressure 112/78. Skin very swarthy. Liver spots. No actual jaundice, although sclerae and palate are a muddy, subicteroid color.

Teeth: Several dead. Tonsils: Large, smooth, pale; nothing expressed.

Nares: Atrophic rhinitis. Pharynx: Hyperemic.

Lungs: Right upper pole doubtful; percussion note dulled; tactile fremitus increased. Breath sounds roughened and prolonged. No rales.

Heart: Myocardial weakness. Action irregular.

Abdomen: Normal appearance. Slight upper right rectus rigidity. Slight tenderness only to deep thumb pressure and deep respiration at gall-bladder point. Gall-bladder not felt. Duodenal point negative. Appendix and cecum negative. Tuning fork test for adhesions negative from stomach through liver and doubtful positive to costal margin. Moderate ptosis of stomach and transverse colon.

Technical Examinations. Blood: Hemoglobin 74 per cent (Dare). Red blood cells 4,100,000; color index 0.9; white blood cells 9520.

Differential: Polymorphonuclears 47 per cent; transitionals 2 per cent; large mononuclears 3 per cent; lymphocytes 48 per cent.

Urinalyses: Negative; no indican; no bile; phthalein 75 per cent in two hours.

Feces: Negative (only one specimen).

Fractional Gastric Analysis: Fasting twelve-hour residuum; no retention; free HCl 15; total acidity 35; occult blood trace; mucus +. Microscopy: Catarrhal infective gastritis.

Digesting: Delayed harmonic response, curve rising slowly to high point of free HCl 20, total acidity 45 at seventy-five minutes. Normal motility, although tonus poor to terminal lavage. Gastric mucosa congested. Occult blood, traces to +1.

Biliary-tract Drainage: Entrance time twenty minutes.

Duodenal fraction: Strongly mucoid; gray fluid. Microscopy showing masses of exfoliative duodenal cells in strands, with attached leukocytes. Bacterial flora diffuse, but no colonies.

"A" fraction 15 cc golden-yellow viscid bile, with increased viscosity and flocculi plus.

"B" fraction appeared promptly, but discharged intermittently to a total of 135 cc deep olive-green-brown, static bile. Very turbid, thick and stringy with numerous mucopus floccules.

"C" fraction light lemon-yellow, clear.

Microscopy of "A," "B" and "C" fractions: Mucus encrusted with bile salts, bile-stained pus cells, swarming bile-stained bacterial flora. Many colonies of cocci. Very little epithelial exfoliation. No crystals.

Bacteriology. Heavy growth of non-hemolytic streptococci in "A" and "B" fractions, predominating in "B."

Roentgen-ray Findings: November 8, 1920. *Gastro-intestinal Tract. Summarized Diagnosis:* Gastric atony, dilatation and ptosis. Cholecystitis, with probably stones and possible adhesions to duodenum.

Remarks: There is no evidence of organic lesion of the stomach. The slight irregularity of the terminal portion of the duodenal cap

is suggestive of non-obstructive adhesions, but from the unusual reverse peristalsis it is difficult to rule out duodenitis as the cause of the irregularity. I feel certain there is not an actual ulceration. The gastric delay is due mostly to lack of peristaltic effort.

The gall-bladder is rather large, but casts only a delicate shadow, which tends to indicate that the walls are not greatly thickened. There are rather strongly suggestive stone shadows, fairly small and of negative density.

There is no evidence of stone in the urinary tract. The kidneys are of normal size and in normal position. The spine and pelvis bone shadows are normal.

Teeth. There is a small defect at the apex of the palatal root of the second molar, upper right. I believe it is essentially an abscess, but this is the only defect that I can find in the dental organs.

Lungs. In the chest the relations and lung shadows are normal except for a few very small scars in the apex of the right lung, and a tendency to peribronchial thickening along the vertebral border of both upper lobes. This indicates some more or less old inflammatory process in this region, possibly of a tuberculous nature. There is no evidence of an active lesion at present.

W. F. MANGES.

Diagnosis. Major. Masked focal infection in gall tract. Cholecystodochitis.

Contributing. Low grade gastro-duodenitis. Toxic myocarditis. Hepatic toxemia? Quiescent pulmonary lesion.

Treatment. Weekly drainage. Autogenous streptococcic vaccine. Pills containing bile salts and pancreatic extract. No change required in diet.

"Follow up" of Case, April 19, 1921. This case made very satisfactory progress. She continued weekly drainage for three months. "B" fraction gradually cleared up from a heavy green-brown to black to normal gross appearance. The first month's treatment was conducted in the office, the next two months' treatment in Florida under the direction of a nurse trained in technic. Progressive improvement. Remarkable increase in endurance and concentration. Marked lessening of swarthinness of skin. Depression and drowsiness gone. Sleep state normal.

During first month of drainage had two very slight attacks, but without nausea or vomiting and no attacks for the past three months.

May 3, 1921. Re-check drainage: Normal gross appearance. Objective microscopical findings all negative.

November, 1921. Has been perfectly well. No attacks of pain for nine months. No drainage for six months.

Sequel. On December 23, 1921, I received the following letter from Dr. Porteous.

"You will be interested to know that three weeks ago our patient, Mrs. X., was operated for acute appendicitis. Early one morning she was taken with acute right sided pains and backache. I found that she was in the throes of an acute appendix involvement with a great deal of pain and tenderness in her right iliac fossa. A leukocyte count, immediately done, confirmed my suspicions, and especially as about this time she had a distinct chill. Dr. Deaver was immediately summoned and she was operated four hours after the onset of her first symptoms, but in spite of us her appendix was ruptured at the base and her pelvis contained sero pus. She had a most stormy time for the first two weeks, not having missed any of the surgical complications, even getting a fecal fistula. Incidentally, her gall-bladder and gall-ducts were examined by Dr. Deaver and observed by me. Apparently everything looked absolutely normal, the gall-bladder being thin walled, bluish, small in size, and emptied most normally. I thought you would be interested to know of these findings, for I really feel now that her trouble in the past has been due entirely to her chronic appendix with referred pyloric symptoms. She is sitting up in bed and her wound is granulating very satisfactorily."

November, 1922. Mrs. X. reported back in response to a follow up and states that since getting over the immediate effects of her operation eleven months ago she has remained perfectly well and has had no recurrence of any attacks of pain.

Discussion. This case presents many interesting features.

1. The history, as recited above, suggested the possibility of a gall-stone colic of irregular type and the roentgen-ray evidence strengthened this view. But the absence of crystals in numerous examinations, together with the steady improvement in the clearing up of a static "B" fraction and of the microscopic objective findings, the absence of referred pain and the clinical evidence against adhesions, led me to believe that she did not have gall stones or extensive cholecystic pathology, and was a favorable case for non-surgical management.

2. I felt that there were clinical features to suggest that the pseudo colic might be due to dysfunction of Oddi's sphincter, producing simultaneous spasm of the sphincter with attempted contraction of the gall-bladder, producing a rise of intra-duct and intra-cystic tension in an inflamed tract. I believe that such a condition may exist as an entity and may simulate stone colic. In support of this view we have the facts that

(a) All attacks began from one to three hours after the evening (or heaviest) meal, when the gall-bladder contracts in response to the hormonal stimuli of food entering the duodenum.

(b) The pain steadily increased to a maximum with sudden relief in the intense severity by

(c) The sense of something suddenly giving way or relaxing, and

(d) The turning point in the attack of pain when she could vomit bile, and

(e) The transient clay coloring of the stools following an attack, but without producing skin jaundice.

The sense of something "giving way" might be due to relaxation of Oddi's sphincter (which may have been locally irritated by the duodenitis); to collapse of the gall-bladder; or to relaxation of the pyloric sphincter or a combination of all three.

3. After analyzing all of the evidence I cannot agree with Dr. Porteous in his belief that all of the attacks were due to a chronic appendicitis for the following reasons:

Historically, the earlier attacks, compared to the operative attack, are very dissimilar. All of the former were distinctly upper right quadrant with no referred pain and with residual gall-bladder soreness, whereas in the latter the pain and tenderness were in the right iliac fossa with pain referred to the back. The appendix attack occurred at a totally different time period, as compared to the former attacks, although this, of course, may mean little.

Laying all of the blame on the appendix is out of keeping with the positive findings of gastritis, duodenitis and cholecystodochitis, with heavy and pure streptococcic infection of the "A" and "B" bile fractions, and with the lack of physical findings involving the appendix.

The evidence seems to point to another instance of multiple focal infection, the gall tract active and the appendix quiescent, with a blocked off lumen. Note roentgen-ray observation: "Appendix not seen, but not tender."

Furthermore, in both appendicitis and cholecystitis symptoms may often be atypical, but as a rule in the former nausea and vomiting precede the onset of pain, and in the latter follow it.

4. Assuming that the gall-tract was producing the chief historical picture, then we can likewise assume that the management by non-surgical drainage was justified and resulted in a clinical cure, both symptomatic and objective. Note the surgical confirmation of our findings against gall stones and against adhesions to the liver. Note the absence of gross pathological changes in the gall-bladder. Note the immediate cessation in the attacks of pain following the use of biliary tract drainage and the coincident improvement in other ways. Could we have expected non-surgical drainage of the gall tract to have aborted an appendicitis capable of giving rise to attacks of the severity described?

Report of Case XXIV.—Illustrates a case of acute cholecystitis in a bad operative risk, so ameliorated as to permit the patient to safely pass through two subsequent pregnancies.

Miss D. S., aged thirty-two years, was referred on May 11, 1920.

Past Medical History. Recurrent tonsillitis up to tonsillectomy in 1916. Grippe almost every winter, with jaundice following attack of grippe in 1916. Several nervous breakdowns, one lasting for two years.

Operations:

1910—Cervical dilatation.

1916—Tonsillectomy.

1917—Appendectomy.

Present Illness. For ten years attacks of biliousness and indigestion, with pyrosis, generalized gas pains and localized pain under right rib border, going through to right back. Severe sick headaches. Roentgen-ray examination in 1917 showed adhesions around appendix, resulting in its removal. Gall-bladder not explored during this operation. A year later had attack of severe colic with vomiting of dark green bile, extreme nausea, and dark green stools lasting several days. The present attack followed influenza accompanied by bronchitis in April, 1920. After these symptoms disappeared had low fever constantly for several weeks, with great tenderness on pressure over gall-bladder, constant nausea, burning in stomach, gaseous, light yellow, offensive stools, constant backache, sleeplessness.

Physical Examination. General appearance that of chronic toxemia, swarthy, pigmented skin. Tonsils out cleanly. Teeth and gums negative. Lungs clear.

Heart: Endocarditis (mitral and aortic insufficiency).

Abdomen: Gall-bladder palpable (?), and marked tenderness. Tuning fork test: Positive transmission from stomach to liver.

Spine: Tenderness over right transverse process, fifth to seventh thoracic. Nervous system under great tension, with melancholia and emotionalism.

Laboratory Examinations. Urinalyses: Negative.

Gastric Analysis: Fasting and digesting biliary regurgitation, evidence of erosive gastritis. Extragastric secretory curve.

Biliary-tract Drainage (Diagnostic). Normal duodenal intubation entrance time. "A" bile grossly normal. Common duct closed on this examination. "B" fraction 180 cc, appeared promptly and under tension; dark golden-brown, turbid bile, with numerous mucopus floccules. Microscopy: acute inflammatory fields, predominating feature.

Culture: Pure streptococcus viridans. "C" fraction grossly normal.

Roentgen ray: Gall-bladder shadow not visualized and no evidence of gall-stones.

Treatment. Hospitalization five weeks, with intermittent biliary drainage, vaccine therapy, rest cure management to restore nervous system. Initial drainages followed by considerable pain, gradually subsiding. Objective findings in biles gradually clearing and general symptomatic improvement.

Operation urged on account of possibility of adhesions. Declined on the grounds of forthcoming marriage and extremely nervous state.

Progress of Case. December, 1922. This patient has continued intermittent biliary tract drainage in another city at irregular intervals. She has safely borne two children, notwithstanding her bad heart and diseased gall-bladder, which certainly could not have been improved by her two pregnancies.

Comment. I consider now that it would have been wiser if this young woman had had her gall-bladder removed, rather than to have relied upon non-surgical drainages, notwithstanding a severe endocarditis, for I believe that operative interference will have to be resorted to and with the probabilities of greater degree of pathology than existed thirty months ago.

On the other hand this young woman was very anxious to marry and rear a family. She wanted to postpone her operation until after she had accomplished this. Both she and her attending physicians have stated that they felt she could not have so safely passed through her two pregnancies without the use of non-surgical biliary tract drainage, which not only tided her over a subacute cholecystitis but protects her liver against a toxemia of pregnancy and took a toxic strain off her damaged heart.

Report of Case XXV.—Illustrates a case of acute cholecystodochitis with cholangitis and obstructed cystic duct favorably responding to non-surgical drainage and vaccines. Illustrates the characteristic objective findings in cystic duct obstruction from intra-duct inflammation.

(Case No. 1207).—Mr. J. G. C., aged thirty-nine years, occupation, engineer, was referred September 6, 1921.

Chief Complaint. Sudden severe knife-like pains along right costal margin, lasting from a few seconds to fifteen minutes day or night since May, 1921, but worse since July.

Past Medical History. Pneumonia at age of fifteen. Abscessed tooth extracted November, 1920. Jaundice, July, 1921.

Operation: Appendectomy (clean), June, 1919.

Present Illness. Excellent health until May, 1919, when pain began in abdomen. Epigastric burning and heartburn. In June, 1919, appendix removed because of severe pain in *left* iliac fossa, then well until May, 1921, when short attacks of sharp cutting, stabbing pain along right costal margin began, lasting for a second up to fifteen minutes, leaving him sore in region of gall-bladder, especially when jolted on train. Since July attacks every second or third day and during month of July was jaundiced, with clay colored stools. Dieted for eight weeks because of pyrosis and bitter taste and vomiting of green-yellow slime. Night sweats quite frequently, though he weighs 190 pounds. Loss of weight 15 pounds in six months. Has been living on restaurant fare and eating irregularly since January, 1921. Wakens with dull headache two or three times a week. Acid regurgitations.

Physical Examination. Strong, robust man, tanned skin. No jaundice; left tonsil suspicious; teeth and gums negative; heart and lungs normal. Abdomen: Liver enlarged. Upper right quadrant rigidity. Mass in region of gall-bladder (right lobe of liver?, gall-bladder?)

Laboratory Findings. Gastric Analysis: Typical extragastric curve with +1 occult blood throughout. Fasting biliary regurgitation. Microscopy negative except for bile-stained pus cells.

Biliary-tract Drainage (Diagnostic). Delayed duodenal entrance time to forty minutes. Oddi's sphincter relaxed. Trace of occult blood in mixed duodenal "A" fraction. Mixed bile and gastric contents flowed without stimulation. Ninety-six cc with thick, brown, clotted, shaggy sediment. This brought instant relief of upper right quadrant distress. This shaggy material was very sticky, blocking up pipette and adhering to glass. Microscopically showed confluent pools of oleaginous material, absorbing Sudan III, with twisted, spiralled, dense mucus encrusted with bile salts. Placing this material in a porcelain dish, no grittiness could be felt. It smooths out like butter, but did not dissolve in ether. Associated with this were many pus cells and increased bacterial flora, bile stained and in masses and colonies. Cultural identity: Non-hemolytic streptococcus, pure.

Preliminary Diagnosis. Intense catarrhal infection with sub-acute inflammation of common duct. Obstruction of cystic duct. Catarrh in smaller ducts, leading to early biliary cirrhosis.

Treatment. The following day a six-hour drainage was given, during which time the cystic duct apparently opened and 75 cc of a green-brown, very viscid bile was recovered, in addition to 280 cc of mixed "A" and "C" bile. The microscopy of the "B" fraction showed quantities of pus cells, with very extensive exfoliation of

tall columnar epithelium and numerous colonies of streptococci. The day following he returned to his home in Ohio with a letter to Dr. W. H. Finley, suggesting that the drainages be continued.

Follow-up. January 16, 1922. Dr. Finley writes: "In reply to your inquiry of the fifth, would say that I drained Mr. C. twice a week for two weeks after his return from Philadelphia. At this time he felt well enough to go to work. After that I gave him four more drainages at about ten-day intervals, which was as often as he could get into my office. I also gave him a full course of the vaccine as directed by you. At present he is working every day, has no tenderness in the region of the gall-bladder and says he feels perfectly well. As far as I can see, he is in as good health as he ever has been. I believe that he was greatly benefited by the treatment and that it saved him an operation."

On January 19, 1922, I replied as follows:

"I am glad to hear your report on Mr. C. and that he has apparently made a very great improvement from his gall-tract infection. According to old standards of criterion of cure he might very well now have reached a symptomatic arrest of his disease. But I know I need not warn you that as long as he has any abnormal objective findings in his bile recoveries he is in danger of relapse unless you can insist upon his continuing the treatments further."

May, 1922: The patient wrote that he has continued to feel perfectly well, is doing full time on the railroad, although of necessity continuing to eat restaurant cooking.

Comment. This case has not yet been followed long enough to ascertain final results. It is often difficult to keep such a patient in line and under treatment sufficiently long enough to meet his individual needs. It is particularly difficult to do this when they pass beyond one's personal observation. I am convinced that many cases of this character can be really cured if the details of their drainage findings are carefully watched and treatment continued if necessary for long periods after the arrest of symptoms has been secured. Many failures in the use of this method might be converted into successes if painstaking attention was devoted to this point. Leaving unrecognized residual or latent infection will inevitably bring about a relapse as soon as the balance of resistance of the individual patient becomes lowered to any remaining infection.

Report of Case XXVI.—Illustrates a case of acute catarrhal jaundice with infective cholelithiasis ascending high enough to produce cystic duct inflammatory obstruction, promptly subsiding with non-surgical drainage alone. Case also illustrates the direct causative factors which so often precede the development of acute catarrhal jaundice.

(Case No. 1273-A).—Dr. H., aged thirty-six years, first seen January 31, 1922.

Family History. Negative.

Past History. Septicemia following rusty pitchfork in foot in childhood.

1911. Severe diphtheria with residual paralysis in legs for several weeks.

1912. Double lobar pneumonia with pleural effusion, slow convalescence.

1913. Double quinsy.

1917. Pandemic influenza in France.

Cystic goiter right lobe.

Operations: Turbinectomy and deflected septum in childhood.

Recent History. About January, 1921, began to have eczema on tips of fingers which would crack open. Skin specialist thought it was due to constant use of surgical antiseptics. About this time had some dental work done, which later gave trouble, an abscess having formed at apex of first molar lower right, which drained into mouth. This tooth was extracted, but no cultures or smears were made. From this time on has been having nausea at irregular intervals, bearing no relation to food. In August, 1921, had a series of fifteen boils. These began as small areas of superficial necrosis developing a deep induration and a superficial pustule. Some of these would form blebs resembling pemphigus. Cultures from these recovered *Staphylococcus aureus*. A vaccine was prepared, three injections were taken and it was then discontinued.

During the summer the Doctor improved in a general sense, except for increased nausea and two additional boils which occurred in November, until January 1, 1922. Then he began to have pains in joints. This involved both large and small joints, with pain, no redness, only slightly swelling of hands at times. No fever. The pain jumped from one joint to another, and involved the spine in the cervical region. Medical consultants thought it was of toxic origin. This acute condition lasted about ten days, clearing up under salicylates.

A few days later he began to notice that urine was highly colored. Nausea became worse and he vomited at intervals, several times at night, sour food remains. Bowels became irregular, tending to constipation, with occasional acholic stools and excessive purgation following salts.

One week ago first noticed that he was jaundiced, and since then it has been getting gradually worse. Pronounced itching of skin. Shoulder joints still painful. For past ten days has also had gnawing discomfort in epigastrium, when stomach becomes empty, but relieved by further food-taking.

Physical Findings. High grade jaundice, sclerae, palate, skin. Fever to 100.5° F. Liver enlarged. No abdominal rigidity, spasm or tenderness.

Laboratory Findings. All negative with the exception of a red-brown urine (giving strong reaction for urobilin) and acholic stools.

Diagnosis. No complete study made. Inference: Catarrhal jaundice with infective choledochitis producing total obstruction.

Treatment. January 31, 1922. Twelve-hour gastric retention; pylorospasm *versus* inflammatory edema; belladonna 20 minims through tube; duodenal entrance time twenty minutes; common duct plugged. No bile response from two magnesium sulphate stimulations or from 50 cc 0.5 per cent HCl. When the latter was introduced it promptly reproduced his symptoms of epigastric pain distress, which the patient says occur when his stomach is emptying. This I consider a useful diagnostic test for duodenitis or duodenal ulcer or pylorospasm due to hyperacidity. Hot solutions were then dripped into the duodenum for several hours, winding up with a transduodenal enema of 250 cc Ringer's solution containing 20 gr. of sodium salicylate and 0.5 per cent sodium sulphate.

February 1, 1922. After yesterday's treatment Dr. H. had rather marked laxation with copious fluid bowel movements in which bile staining was evident. He slept well and this morning woke feeling distinctly better, and with an absence of nausea for the first time in several weeks. Today his stomach showed no retention, and his washings showed a distinctly cleaner stomach.

On getting into the duodenum the duct was found slightly open and after one stimulation with magnesium sulphate we began to recover large quantities of shaggy sheets of apparently mucus. *Microscopically*, these sheets were bile stained at one edge and unbile stained at the other, and instead of simply being made up of mucus, they proved to be exfoliated bits of mucosal epithelium which at the unbile-stained end consisted of oval and cuboidal cells, most of which showed vacuolizations, granular degenerations and evidence of necrosis, whereas the bile-stained end was made up of bile-stained short columnar epithelium, pus cells and necrotic inflammatory debris, together with bacteria in colony formation. There was not, however, much diffusion of these bacteria through the thinner fields. When put into a Wassermann tube with 10 per cent formalin the amount of this flocculent sediment packed down to seven-eighths of an inch.

After draining out these larger flakes, some of which flattened out under a cover slip with a width of 1 to 1.5 cm., we began to recover numerous smaller flakes, more definitely bile stained, in which the cells were still partly cuboidal, but chiefly columnar, semi-necrotic, but relatively in a better state of preservation. Still

later we recovered denser fine shreddy flakes of a bright yellow appearance which microscopically appeared to be very dense shreds of mucus heavily encrusted over with amorphous bile salts and containing many globules appearing like neutral fats staining with Sudan III which, after standing on an artificially lighted microscope stage, quite rapidly seemed to melt down into confluent pools and lakes of the same bright yellow oily looking material which we have seen in a number of other cases, and believe to be strongly suggestive of cystic duct obstruction from inflammation within. (See Case XXV.)

In this case also we failed to recover gall-bladder bile, and assume that the catarrhal process producing his jaundice has risen high enough in the common duct to be also involving and blocking off the cystic duct. This oleaginous material is so fluid that with air currents passing under the cover slip it is seen to move in rather freely flowing streams between the streams of dense spiralled mucus.

Further similar treatments were given on February 3, 8, 10 and 13. All jaundice cleared on February 3 and mucopus floccules steadily diminished and on February 8 gall-bladder bile ("B" fraction) was secured. Cultures from latter recovered streptococcus non-hemolyticus and Staphylococcus aureus.

On February 13 the objective findings, though better, still persisted, but Dr. H. felt so completely relieved that he discontinued further treatment. He remained well with no recurrence of any of the symptoms recorded in present illness until December, 1922, when by telephone he stated that he had recently had a recurrence of the postmeal epigastric distress, which was relieved by the use of the antacid powder described on page 476.

Discussion. 1. This case represents one of catarrhal jaundice plus infective cholecystodochitis of average severity, promptly terminated by a short period of direct treatment.

2. The incidence of cause and effect in the swallowing of infected material from teeth and probably tonsils, setting up a gastroduodenitis with perhaps mixed ascending and descending infection of gall tract.

3. Although this might be considered a favorable result, this patient stopped treatment too soon, and is very apt to have a relapse and gradual development of later gall-tract pathology. Since the abnormal objective findings had not completely disappeared, he should have persisted in topical treatment and drainage and the use of autogenous vaccines beyond the point of simple symptomatic cure. The note of recurring symptoms of postmeal distress in December, 1922, may be the beginning point of such a relapse.

CHAPTER XXXIII.

REPORTS OF CASES.—(CONTINUED.)

Report of Case XXVII.—Illustrates the difficulty in correlating the historical, physical and laboratory data after careful study and proving the correctness of such diagnosis at the operating table. Yet some doubt still reasonably exists as to whether a chronic appendicitis in this case could alone explain all the symptoms and physical and laboratory findings or whether a later follow-up will show that the surgical exploration failed to disclose all of the existing pathology.

Mr. E., aged forty-two years, was referred to me on April 10, 1920. For eight years he has had attacks of recurring pain or distress and a sense of gnawing and weight discomfort in the epigastrium with bloating and belching. When severe the pain was referred to the back and occurred one to three hours after meals and was relieved by eating or vomiting. The attacks were always apt to occur in the spring of the year.

Physical Examination. Pulse 72; blood-pressure 102/70. Very sallow with subicteroid tinging of scleræ and hard palate. Two dead molars; gums clean; tonsils retracted, inflamed, cryptic. Lungs negative. Heart muscle weak. The abdomen showed no rigidity, but tenderness on deep pressure over the gall-bladder point and pressure over McBurney's point elicited pain referred to the epigastrium. The tuning-fork test suggested adhesions of the stomach or transverse colon to the gall-bladder region. Spinal tenderness third to sixth thoracic and tenth thoracic to the left. Hemoglobin 90 per cent. Leucopenia with relative lymphocytosis. Wassermann negative.

Gastric Analysis. 50 cc twelve-hour residuum, lemon-yellow with 4 cc heavily bile-stained granular sediment. Microscopy: much bile-stained columnar epithelium from gall tract, numerous pus cells and heavily bile-stained bacterial colonies of cocci. Free HCl 40; total acidity 60; occult blood negative in filtrate, but weakly positive in bile stained granular sediment. Fractional curve showed normally rising curve to ninety minutes, reaching free HCl 25, total acidity 50, and at one hundred and twenty minutes sharply rising to free HCl 55, total acidity 82.5. No biliary regurgitation.

Occult blood negative in all fractions. Motility normal. *Impression* Stomach negative; extragastric (gall tract) pathology.

Biliary-tract Drainage. Duodenal entrance time twenty minutes. Well marked exfoliative duodenitis, catarrhal exfoliative cholecystitis with stasis and atony. Green-black "B" bile and pure cultural recovery of hemolytic streptococcus.

Stools. Negative for occult blood.

Roentgen Ray. (Dr. Manges). Stomach normal. Duodenal cap slightly irregular, might be due to adhesions. Gall-bladder shadow definitely seen, no stone shadows. Appendix not visualized. *Impression;* Duodenal ulcer, probable cholecystitis.

April 20, 1920. Opinion rendered: Chronic infective cholecystitis, Chronic duodenal ulcer. Hospitalization and medical management for ten weeks was urged. Declined. Intermittent biliary-tract drainage was then begun, after the tonsils had been removed. The tonsil culture recovered only the hemolytic streptococcus. Vaccines of both were prepared and used alternately with weekly drainage of gall-bladder to a total of ten. The gall-bladder atony and state of inflammation cleared and general systemic improvement followed. Streptococcus no longer recoverable from bile by culture nor found in fresh or stained spreads.

Comment. Based on the history this case suggested duodenal ulcer, but biliary drainage also showed involvement of the gall tract and suggested a primary focus of infection in the tonsils transplanted to duodenum and gall tract.

Follow-up. October, 1920. Below par for several days. Left upper molar (dead or dying) producing neuralgia.

October 28, 1922. Reported that he has remained well and able to do hard concentrating desk work without his usual fatigue. In spring of 1922 felt run down and in July went to Maine, felt better, worked out-doors, smoked moderately and ate heartily of highly seasoned rather rich cooking. After some extra heavy work and a cold swim had a sharp pain in back and lower thoracic region, left side, as though a nerve was pinched. This lasted about three days and cleared up, but he noticed that any draught or wet feet gave him a stiff neck. Began at this time to have epigastric discomfort after meals with extreme belching attacks. This discomfort gradually developed into severe gnawing epigastric pain one to three hours after meals. On his return his dentist sent him to an oral surgeon to have a small discharging cyst from left upper gum margin removed. Cyst contained pus. Since then no more muscular pains, but for past two weeks has had increasingly severe epigastric post-meal and nocturnal pain relieved by soda.

Re-study: Physical Examination: Abdomen: No mass, no spasm, slightly increased rigidity upper right rectus. Tender point $2\frac{1}{2}$ inches below xyphoid. Pressure over McBurney's point refers pain

to epigastrium. Tuning fork test +2 to costal margin. Blood: Hemoglobin 88 per cent; white blood cells 3,600; polymorphonuclears 65 per cent; transitionals 3 per cent; large mononuclears 6 per cent; lymphocytes 26 per cent. Stools: Occult blood negative.

Roentgen Ray. October 23, 1922 (Dr. Manges). Stomach vigorous peristalsis. Small residue at six hours. Duodenum fills irregularly with much more marked involvement of duodenal cap. Tender point definitely localized to duodenal cap. Appendix seen, free mobility, normal position. Tenderness present, but very slight, hardly important. *Impression.* Duodenal ulcer.

Remarks. Reëxamination shows that the duodenal condition is almost exactly as at the former time with the exception of slight increase in the deformity of the cap. There is also fairly definite gastric delay at this time. The gall-bladder signs are not as suggestive as they were on the former study.

October 31, 1922. Consultation with Dr. Rehfuß. Findings reviewed. *Opinion:* Organic lesion involving the duodenum. The evidence seems to indicate an old chronic ulcer involving the first portion of the duodenum with considerable fixation and many indications suggesting pericholecystitis. We agreed that medical treatment ought to relieve him temporarily, but with danger of flare-backs and the possibility of some sudden surgical emergency. Operation decided upon with one month of preparatory treatment, bed rest, ulcer diet, belladonna, antacid powder.

After one week complete symptomatic relief. By November 24 had gained 9 pounds and considered ready for operation.

December 11, 1922. *Operation.* Operation, Drs. Gibbon and Despard. Gas ether anesthesia. Upper right rectus incision. Duodenum delivered freely, admitting of good exposure and no evidence of ulcer or scar was perceptible to sight or touch on either anterior or posterior wall. Stomach thoroughly examined by sight and touch and no evidence of any pathology noted. Gall-bladder exposed and had normal bluish-gray appearance, thin walled, contained no stones and emptied readily by digital pressure. Starting from the inferior surface of the fundus and carrying down to the neck of the gall-bladder extended a line of adhesions from top to bottom between gastro-colic omentum and duodenum. These adhesions did not appear to constrict or angulate either the gall-bladder or the duodenum, and were not of the dense inflammatory variety and were comparatively easily separated, and a piece of the omentum was laid over and sewed to protect as far as possible against future adhesions. Cecum delivered. Appendix found recto-cecal, adherent and pointing toward right pelvis and partly concealed by a typical Jackson's veil. When removed the appendix was definitely pathological, about $4\frac{1}{2}$ inches long, with partially contracted proximal lumen and contained seven distinct and hard

fecal concretions. Mucosa grayish-red, studded over with minute reddish dots.

Drs. Gibbon and Despard felt it better judgment to close up without any further surgical correction.

January 8, 1923. Stormy postoperative recovery. Leaves hospital to go South and take time in convalescing with post-surgical follow-up régime.

Discussion. This case teaches many lessons. Most prominently, to maintain a humble spirit in diagnosis and to realize that even after careful study mistakes can be made. *If* the appendix alone was responsible for all symptoms and findings reviewed above, it emphasizes again how protean the complications of a chronic appendicitis may be and how difficult diagnosis may be in such cases. Clinically, I should have judged this case to be well illustrative of a triplex infective lesion transplanted from tonsils, resulting in a chronic duodenal ulcer, chronic appendix and a subacute cholecystitis relieved by biliary-tract drainage. Note the roentgen-ray finding of improvement regarding the gall-bladder. Note the reliability of the tuning fork test. The symptomatology might be much more easily explained had the appendix been found pointing north to the upper right quadrant instead of found in the right pelvis. I have seen similar cases operated in which the clinical, laboratory and roentgen-ray findings all pointed to chronic duodenal ulcer, but surgical exploration revealed nothing beyond a chronic appendix. *But* several months later in 2 cases a duodenal perforation has followed, and in several others hematemesis or profound concealed hemorrhage suggested that an ulcer was present, but surgically not demonstrable.

I do not believe that this sequel should occur with this case since the surgical exploration was as complete as I have ever seen.

Report of Case XXVIII.—Illustrates the necessity of a careful search for and removal of the etiological causative factor producing ulcer of the stomach or duodenum before proceeding to adopt a plan of either surgical or medical cure, if later complications and recurrences are to be avoided.

Dr. S., aged forty-three years, first presented himself May 8, 1919.

He gave the following history. About six years previously he had been operated upon for the relief of a duodenal ulcer on the posterior wall of the duodenum which was causing partial obstruction. With very little preliminary study a gastroenterostomy alone was done. He made a poor response to surgery and within a few months symptoms of a slightly different type reappeared, and kept on progressing and finally took him back to the operator, who said there was nothing more to be done. He then went to a most import-

ant surgical clinic and they corroborated the first surgeon's opinion. He continued to suffer with ulcer symptoms, but during the war was ordered to France, and due to improper diet continued to get worse.

On his return in January, 1919, he went back to the second clinic and was then taken up for operation. He was found to have a marginal ulcer at the distal lip of the stoma. The operator closed the gastro-enterostomy, did an end-to-end anastomosis of the jejunum, demobilized the duodenum and did a Finney pyloroplasty, and let him go.

They, too, failed to hunt for, or at least failed to find, the primary focus which had produced both ulcers. The patient made a stormy postoperative recovery and within a few months redeveloped the same type of postmeal hunger distress and pyrosis, but modified as to time interval on account of the changed motility due to the rapid emptying of his stomach following the pyloroplasty.

A fractional gastric analysis on May 8, 1919, easily demonstrated the fact that he had a hemolytic streptococcus infection both in the stomach and duodenum. Where was it coming from? This meant careful search for focal factors of infection above the stomach. His teeth and gums were negative. His sinuses and bronchial tree gave no clues and casual inspection of his pharynx and tonsils showed nothing suspicious on half a dozen examinations, except that the posterior pillars of the tonsil were bound down and the tonsils could not be pressed forward. He had *never* had tonsillitis. Finally the posterior pillars were dissected free and nearly a teaspoonful of foul, offensive pus welled out, and smears and cultures recovered no other bacterium except the hemolytic streptococcus. Here, then, was the presumable source of all his trouble. The tonsils were removed and a vaccine prepared.

It took a year to get this man back to health, during which time he had much topical disinfectant treatment to his stomach and duodenum, and vaccine therapy, coupled with general management. His hemoglobin at his lowest point was well down in the thirties. Now it is in the nineties. His weight was 40 pounds less than his normal. Now it is all regained. His strength and efficiency in work were badly reduced. Now he is doing about 90 per cent of his work and doing it efficiently.

Comment. One should constantly remember that before any ulcer case is definitely taken up for treatment, whether this treatment be medical or surgical, an earnest attempt should be made to determine the etiological type and source of the ulcer with which one has to deal. It would be very foolish to withhold specific therapy and instead to operate on a syphilitic gastric or duodenal ulcer, ignoring the fact that the ulcer was being produced by lues. Again, and more importantly, it is never wise to operate for ulcer

of infectious origin and perform a gastroenterostomy and expect to see the patient get well if we leave behind the primary infection in purulent tonsils or a "dirty," septic mouth. It is often in this manner that postoperative marginal ulcers are created.

Primary jejunal ulceration is unquestionably a rare condition. I question whether or not such jejunal ulcerations are indeed primary and not secondary to or coincident with unrecognized infection or ulceration in the stomach, duodenum or gall tract, and all of them derivable from some focus of infection in the respiratory, nasal and paranasal tracts or from foci in tonsils, gums and teeth.

Gastro-jejunal or so-called marginal ulcers are seen much more frequently and here the evidence of their being secondary to foci higher up becomes more apparent. The usual etiological explanation of the development of these ulcers has been ascribed to the non-absorbable suture material used in the performance of the gastro-enterostomy or as a result of trauma from improperly applied clamps. Conceding these possibilities, I nevertheless feel that some additional emphasis should be laid upon the infectious origin of marginal or gastro-jejunal ulcers, which so closely follow the primary operation, and I believe that in a majority of the cases the two factors mentioned above will represent retarding influences in the healing of the lesions without themselves being the producing cause of the ulcer. I, moreover, believe that the great majority of ulcers are infectious in origin or, more properly speaking, are produced as a result of infection acting upon mucosal zones of diminished resistance.

A similar analogy could be brought forward to explain simultaneous gastritis, duodenitis, with or without ulcer, and infective cholecystitis, appendicitis and sigmoiditis. The same extragastric focal infection, especially when of high virulence and draining directly into the gastro-intestinal tract, can and frequently does produce multiple secondary lesions.

The site of gastro-jejunal ulceration is generally along the margins of the stoma. The posterior margin is more commonly affected and the distal lip of the stoma is more frequently involved in cases of secondary causation in which the ulceration is being produced by infective agencies draining through the new gastric opening, whereas the proximal lip of the stoma is more commonly attacked in cases which show concomitant infection in the gall-bladder or bile ducts. Less frequently the ulcer will be in the jejunal wall opposite to the stoma and overlying the attachment of its mesentery.

There has been very little work done in regard to the actual pathology of these ulcers. They are more apt, however, to be small, linear, and more superficial than those usually occurring in the stomach and duodenum. It is possible, however, that in this zone, just as in gastric and duodenal ulceration, the more superficial ones

heal readily, before they have given rise to interpretable symptoms or objective findings.

Inasmuch as marginal ulceration is comparatively rare and because its symptomatology is less clearly understood than is that of simple gastric or duodenal ulceration, I believe a little further discussion of this subject, based on my personal experience with proved cases, may not be superfluous.

Pain is of frequent occurrence, is constant as to its duration over many consecutive weeks and with less of the spontaneous remission common to duodenal ulceration; it is more inconstant, however, as to temporary relief through food-taking or the use of alkaline powders as in gastric or duodenal ulceration. The most severe pain occurs as in duodenal ulcer from one to three hours after eating and the time interval seems to bear a certain relation to the motor function of the gastro-enterostomy. The pain has been generally thought due to the corrosive action of a hyperacid gastric juice and at times assumes the suggestiveness of a pyrosis. In certain cases, however, the pain is not due to hyperacidity, but, on the contrary, is found to be caused by a hyperalkalosis. For in fractional gastric studies on some such patients it will be seen that at some point after the forty-five minute period, bile is regurgitated back into the stomach in larger and larger quantities and the gastric acidity curve rapidly drops to the alkaline side.* With this regurgitation will be found the direct diagnostic evidence of blood, pus, bacteria and inflammatory debris and the beginning of pain is coincidental with the regurgitation of bile and increases in severity with the increasing bile reflux. One would assume from this that the alkalinity is developed from the bile itself. This is probably not true, however, inasmuch as bile from the gall-bladder and gall ducts when freshly recovered from the duodenum or at operation, I have found to be acid in reaction, varying between 25 and 45 degrees of acidity when titrated to phthalein. Therefore the alkalinity of bile found in the jejunum is probably due to its admixture with the succus entericus. That this phenomenon of biliary regurgitation is not a physiological compensatory one designed to overcome a supposed hyperacidity is evident by the therapeutic test of administration of hydrochloric acid which will often serve to relieve the pain where alkalis aggravate it. I have seen certain patients who have gotten their greatest symptomatic relief from this measure, and, in addition, they have found that lying flat on their backs on the floor or a hard couch is the postural position most apt to relieve their distress. This position may in such cases prevent the regurgitation of bile across the marginal ulcer and into the stomach.

The preoperative diagnosis can be most easily and accurately made by means of the duodenal tube and the microscope. Roentgen ray as a rule will not disclose or differentiate this pathological lesion.

* See Fig. 84.

Very little has been accomplished in the treatment of postoperative marginal ulceration by any method of medical management, and surgical interference probably offers the greatest prospect of permanent correction, although the operative technic is most difficult and the mortality risk is high. In no case, however, will the *infective* type of this condition be likely to be permanently cured by either surgical or medical procedures if the primary source of the infection is unrecognized or disregarded as has been stated above.

Report of Case XXIX.—Illustrates a case of syphilitic pyloric ulceration with gumma, producing an acute and complete obstruction of a type where surgical correction alone seemed possible, yet responding satisfactorily to a proper medical régime.

Apropos of what was mentioned in the last preceding case report, in regard to ascertaining the etiological factor concerned in the production of a gastric lesion suggesting ulcer or simulating it, brings back to memory a patient who was under my hospital service three years ago. He was a ward patient and the notes of his case are not before me. But I remember the general run of it very well:

This patient was a robust adult male, who had been admitted to the hospital with constant vomiting over a consecutive period of several weeks. Vomiting was of the retention variety. He had lost considerable weight on account of inability to retain sufficient nourishment. Fractional analysis showed high acid curve and occult bleeding quite pronounced in all fractions, together with overnight retention, which had to be removed before the analysis could be made. Roentgen fluoroscopic and plate examination showed a complete obstructive pyloric lesion with a dense infiltrating mass at the pylorus. This mass was readily palpable on physical examination. A surgical conference was held, and operation was decided upon. The day before operation a Wassermann report was turned in from the laboratory, giving a strongly positive reaction. The patient was put on intensive syphilitic treatment by mouth, skin and vein with prompt subsidence in the pyloric obstruction. The stomach gradually became retentive and six weeks later the patient was discharged, free of all presenting symptoms, and was referred back to the dispensary for follow-up antiluetic management.

This case was followed for two years before he passed out of my personal observation, and during that time had remained perfectly well and continued his specific treatment faithfully.

It also illustrates how inexcusably foolish it would have been to have done an exploratory operation, perhaps excising a gummatous new growth, mistaking it for malignancy, or to have done a posterior gastro-enterostomy for a mistaken non-luetic pyloric ulcer.

CHAPTER XXXIV.

REPORTS OF CASES.—(CONTINUED.)

I AM indebted to Drs. Smithies, Karshner and Oleson of Chicago for the privilege of presenting the following 10 case reports of patients who were seen and studied by them.

Report of Case XXX.—Case illustrating harmlessness of biliary-tract drainage in jaundice complicating lobar pneumonia, with relief of all symptoms after one treatment.

Mr. C. O., aged sixty-one years.

Past. Nothing of importance.

Recent. Bilateral, acute lobar pneumonia developed seven days ago.

Present. Patient very ill from pneumonia, heart dilated. On *sixth day* of pneumonia, acute rapidly progressing *icterus*, with succeeding pronounced enlargement of *liver* and increased cardiac embarrassment, contraindicating surgical relief even under local anesthetic.

Examination. Temperature, 103° F.; pulse 144; respiration 42. Large male with pronounced cyanosis of mucous surfaces, marked dyspnea, engorged neck veins, deep general icterus, Dilated heart ventricles. *Liver:* Enlarged 4 inches below right costal arch; tender, soft. *Gall tract:* Dulness lying below Riedel's lobe with tenderness suggesting distended gall-bladder.

Gall tract Drainage. Employed only as therapeutic agent.

Treatment. Duodenal bulb passed to stomach by wire staff, carried through pylorus within half an hour; MgSO₄ stimuli followed by prompt response from engorged bile passages, gall-bladder and liver.

Result. Liver receded beneath costal arch within twelve hours; palpable gall-bladder (?) lost in three hours, icterus absent in twenty-four hours; patient passed through a normal crisis. No biliary tract upset since. (One and a quarter years.)

Report of Case XXXI.—Case illustrating recurrent rheumatoid periostitis relieved after removal of several infective foci and drainage of 130 cc creamy pus from the gall-bladder.

Dr. W., Chicago physician, aged fifty-four years.

Past. Pneumonia at age forty-six years; typhoid fever at age thirty years.

Present. For four years interval attacks; sudden pains in legs and arms (once ankle and knee); localized swelling, redness, tenderness; last several days; fever 101° F. in attacks. *No other complaints.*

Physical. Infected tonsils. Tender, palpable, swellings edge of right ribs. Mid-ulnar segment right arm, dusky red, elevated swelling (4 cm. in diameter), tender and deep seated.

Laboratory. Blood (mild) secondary anemia; leukocytes 11,500; lymphocytes 36 per cent. Urine: oxaluria. Phthalein test 80 per cent. Stomach, free HCl 32, total acidity 64; no retention. Stool: Undigested meat and fat. Roentgen-ray: Teeth, root abscesses. Gall tract: Enlarged gall-bladder, no calculi. Stomach, colon, kidneys and thorax, negative. Long bones, localized periostitis under surface of right forearm.

Biliary-tract Drainage. 1. Duodenal fraction normal. 2. *Common duct, gall-bladder fraction*, 130 cc, thick, creamy, foul smelling pus containing streptococci, large staphylococci and *B. typhosus*. 3. Hepatic duct fraction, pus and few cocci.

Treatment. Biliary-tract drainages; autogenous vaccine; removal of tonsils and teeth.

Result. Clinical recovery; no further attacks of periostitis or rheumatoid pains.

Report of Case XX XII.—Case demonstrating diagnostic value of biliary-tract drainage in revealing flagellate protozoal cholecystic infection in case where repeated stool specimens were uniformly negative. (Compare with case reviewed in Chapter XXI.)

A. F., aged eight years.

Past. Whooping cough, chicken-pox; adenoid-tonsillectomy (incomplete); scarlet fever.

Present. Gastro-intestinal attacks; fever 103° F.; nausea, vomiting, prostration; bradycardia, undernourishment, secondary anemia.

Physical. Pale, undernourished; adenoids; slight compensated mitral stenosis; liver dullness, 5½ cm.; definite well delimited, local tenderness at right rib edge (gall-bladder zone?); distended cecum and ascending colon; very restless but without choreiform movements.

Laboratory. Blood, mild chlorotic type anemia; lymphocytes 62 per cent; eosinophiles 2.5 per cent; Wassermann negative. Urine, negative (chemically and culturally). Stomach, free HCl 22, total acidity 48; no retention. Stool, alkaline; colon type bacilli. Many Gram-plus cocci and bacilli, no parasites, even on repeated

search. Roentgen-ray: Right *heart* slightly enlarged. Stomach; *gall tract* and *kidneys* normal. Colon, moderate degree of atonic dilatation.

Basal Metabolic Rate. Plus 14 per cent.

Gall-tract Drainage. Diagnostic.

D—Fraction—Budding yeast and fungi.

A—Fraction—Yeasts and fungi.

B—Fraction—Dark bile, mucoid, crystals increased and enormous masses of active *cercomonads*.

C—Fraction—Free flow—normal bile.

Treatment. Biliary-tract drainage at weekly intervals. Low fat and low protein diet; iron and arsenic daily, calomel and salts monthly.

Result. Yeasts and fungi disappeared after second drainage. No recurrence of digestive anomaly. *Cercomonads* never found except in gall-bladder fraction. Present there only in small mucous masses floating as flocculi. Numbers and motility gradually decreased. At last drainage (September 29, 1922), bile secured was normal in all fractions. Boy gaining about a pound a month in weight; subjectively well and back in school.

Report of Case XX XIII.—Case illustrating rapid therapeutic relief in obstinate catarrhal jaundice through biliary-tract drainage. Patient remained well for seventeen months. Death from gastric carcinoma with numerous hepatic metastases.

Dr. P. F., Chicago physician in active practice, aged fifty-four years, referred by Dr. R. H. Babcock.

Past. Measles, whooping cough, exudative pleuritis at twenty-eight years; "rheumatism."

Recent. Four weeks ago "ptomain poisoning" (sardines); acute enteritis with diarrhea; anorexia; fever 99 to 103° F.; *ten days later* "clay colored" stools, itching, progressive *icterus*, "smoky" urine.

Present. Intense general jaundice; soreness in liver region; malaise; itching skin.

Examination. Temperature 99° F. (A.M.); pulse 80; respiration 16.

Physical. General *icterus*; scratch marks; infected gums and teeth roots; enlarged left ventricle; arteriosclerosis; blood-pressure, systolic 198; diastolic 94. *Liver* much enlarged, reaches navel, tender. Spleen enlarged, palpable plus. *Gall-bladder zone*—very tender, dull to percussion; gall-bladder palpable (?). No ascites. *Pancreas*—palpable (?).

Laboratory. Blood: Hemoglobin 80 per cent; red blood cells 5,180,000; white blood cells 18,800; Wassermann 0. Urine: Bile

pigment; albumin, trace. Stool: Alkaline, light brown; urobilinogen plus; steatorrhea plus. Stomach; free HCl, 20, total acidity 44; no retention. Prostatic smear: Diplococci (extracellular).

Biliary-tract Drainage. Thirteen ounces black-brown, thick opaque, turbid bile (right costal swelling [gall-bladder] disappeared during drainage) containing much cholesterolin, bile pigment and epithelial débris. Culturally, *B. pyocyaneus*, streptococci and *B. coli*.

Treatment. Biliary-tract drainage each second day; liquid and soft low protein and fat diet; arsphenamine-salicylates.

Result. After third drainage, liver and spleen, no longer palpable, patient afebrile, no liver tenderness. After seventh drainage icterus almost gone, diarrhea ceased, appetite returned. After tenth drainage, patient of normal color, urine and stools normal; discharged as well. Remained so for seventeen months—then recurrence of jaundice.

Second Physical Examination. Pronounced emaciation, cachexia very deep icterus. Large nodular liver extends half-way from costal margin to navel. Leukocytosis 35,000. Fever ranging from 99° to 104° F., septic type temperature. Marked secondary type anemia.

Course. Rapid *exitus letalis* in spite of transfusion of whole blood.

Autopsy. Small (thumb-nail sized) ulcerating carcinoma on posterior gastric wall near lesser curvature directly adherent to, and involving pancreas. Liver a mass of metastases. Gall-bladder large, distended, thick walled, containing pus and multiple mural abscesses.

Comment (Dr. Lyon). I, at first, mentally questioned the advisability of using this case report, although it is a most interesting one of itself. But since it presents several obvious lessons I feel it should remain.

Report of Case XXXVII.—Case illustrating symptomatic relief obtained in the presence of inactive duodenal ulcer after drainage of the biliary tract.

Mr. H. A. O., aged forty-five years.

Past. Appendectomy at twenty-eight years; drainage frontal sinus at forty-two years.

Recent. Twenty years intermittent ulcer type dyspepsia (six to eight attacks yearly); "bilious," during last six years, with alternating diarrhea and constipation, associated with generalized headaches; weight loss, 15 pounds during last nine months.

Present. Comes during "ulcer" attacks; nausea, anorexia and occasional vomiting.

Examination. Temperature 98.4° F.; pulse 62.

Physical. Undernourished, tired-looking, rather pale male, infected gums and teeth roots; myocardial weakness; blood-pressure, systolic 108; diastolic 63. *Abdomen:* Scar of appendectomy; marked spasm and tenderness over anatomical zones of duodenum and gall tract; enlarged stomach; colon dilated.

Laboratory. Stomach: Free HCl 30; total acidity 74. Stool: Blood (benzidin test) +2; mucus in excess. Urine: no anomaly; Phthalein 80 per cent. Blood: Hemoglobin 75 per cent; red blood cells 4,240,000; white blood cells 9,400; Wassermann 0.

Biliary-tract Drainage. Pyloric spasm (?); bulb passed slowly to duodenum.

1. *Duodenal fraction:* Fresh blood; mucus, epithelium in excess.

2. *Common duct and gall-bladder fraction:* 260 cc green-black, opaque; mucoid granular sediment. *Microscopically:* Excess of epithelial debris, cholesterin, bile pigment, mucus. *Cultures:* B. coli, B. pyocyaneus, diplococci.

3. *Hepatic duct fraction:* Muddy brown, turbid, containing diplococci and pyocyaneus (?). *Roentgen ray:* Persistent duodenopyloric deformity (ulcer), with early stenosis. Enlarged gall-bladder shadow; no calculi.

Treatment. Eradication of focal infections about head; carbohydrate diet; belladonna; mineral oil; iron. Biliary-tract drainage at weekly intervals; autogenous vaccine.

Result. After six months, no ulcer attacks (previously they came six to eight weeks' intervals); "biliousness" absent; patient well and comfortable, gained 23 pounds.

Report of Case XX XI.—Case illustrating value and harmlessness of biliary-tract drainage in jaundice appearing as a late complication of scarlet fever—with relief after one treatment.

Miss D. B., aged ten years.

Past. Measles; whooping cough; chicken-pox.

Present. Recent scarlet fever with progressive icterus late in convalescence; fever.

Complaint. Malaise; dyspepsia; vomiting; right epigastric pain; itching skin; jaundice (eight days).

Examination. Temperature, maximum 102° F., pulse 110; respiration 22.

Physical. Undernourished; general icterus; flushed face. Liver: Enlarged, palpable, tender. Spleen: Enlarged, palpable, tender. Gall-bladder enlarged distended, palpable, very tender.

Laboratory. Blood: Hemoglobin 80 per cent; red blood cells 4,890,000; white blood cells 19,600; polymorphonuclears 60 per

cent; Wassermann 0. Urine: Bile pigment +, +; calcium oxalate. Stool: Pale creamy yellow, fatty; hydrobilirubin plus.

Biliary-tract Drainage. Duodenal bulb passed pylorus in fifty minutes.

1. *Duodenal fraction:* 60 cc bile stained, mucoid.

2. *Common duct, gall-bladder fraction:* 150 cc dark yellow; thick opaque bile, foul odor, much sediment. *Culturally:* Short chain streptococcus, *B. influenzae*. *Microscopically:* Excess cholesterin and bile pigment.

3. *Hepatic duct fraction:* Free drainage thick, opaque, orange colored bile, rich in mucus, pigment, pus cells, cholesterin. *Culturally:* Streptococci.

Treatment. Biliary-tract drainage, low fat and low protein diet; salicylates.

Result. On second day, icterus had disappeared, liver and spleen not palpable, no gall-bladder tumor or tenderness, temperature normal; leukocytes 7,200; patient subjectively well and remains so (eleven months).

Report of Case XX XVI.—Case illustrating the therapeutic value of biliary-tract drainage in a class of cases where the surgeon is at the end of his resources. (Compare with Cases I, XVI and XVII).

Mrs. Dr. Mc. I., aged forty-six years.

Past History. "Bilious attacks" since childhood; intense jaundice fifteen years ago.

Operative History. Partial hysterectomy (Murphy, 1914); cholecystectomy (W. J. Mayo, June, 1917); stab drainage July, 1917 (J. C. Webster).

Complaint. Well one year after gall-bladder operation, then right costal pain, jaundice. Clay colored stools; eminent surgeons, again consulted, advised against further operation. *At present:* Headaches, dizziness, hepatic region pain, nausea, irregular type dyspepsia.

Examination. Physical: Liver enlarged; edge $3\frac{1}{2}$ cm. below costal arch, tenderness over common duct zone; head of pancreas swollen, tender, palpable; infected tonsils; psoriasis.

Laboratory. Stomach: Free HCl 29; total acidity 74; no retention. Stool: Alkaline, hydrobilirubin, ++, blood 0; colon group bacilli ++. Urine: No anomaly; Phthalein 65 per cent. Blood: Hemoglobin 85 per cent; red blood cells 4,530,000; white blood cells 9,300. Differential: Lymphocytes 28 per cent; polymorphonuclears 70 per cent; eosinophiles 1 per cent; basophiles 1 per cent; Wassermann 0. Chemistry: Nitrogen 21 mg. per 100 cc blood.

Roentgen ray: Gall-tract: No opacities suggesting calculi; stomach, duodenum, kidneys, negative; colon, atonic type of stasis.

Biliary-tract Drainage. Diagnostic. 125 cc dark, turbid bile, much mucus in masses; pus + +; colon B. + + +; staphylococcus + +; cholesterin + + +; few red blood cells.

Treatment. Biliary-tract drainage at weekly intervals, repeated $MgSO_4$ stimuli; at each treatment from 240 to 600 cc dark, pus-laden bile, exhibiting bile pigment, cholesterin and rich bacterial flora recovered. Low fat, low protein diet; calomel; salicylates.

Result. Liver to normal size (3 drainages); disappearance of pancreatic tumor and local epigastric tenderness; free bile flow with pronounced reduction of abnormal elements after fourth drainage. Dyspepsia and headaches greatly alleviated. Patient refused further treatment after ninth drainage; said she was well and needed nothing further.

Report of Case XX XVII.—Case illustrating value of biliary-tract drainage in chronic invalidism associated with persistent liver infection with formation and expulsion through the duodenal tube of tiny hepatic calculi in patient upon whom all practicable surgical procedures have been performed without relief. (Compare with Case XIII.)

Mr. H. P., aged thirty-two years, teacher.

Operative History. Tonsillectomy; cholecystectomy; gastro-enterostomy (duodenal ulcer). A. J. Ochsner, operator.

Complaint. Hepatic region pain; chronic diarrhea; pyrosis; belching; weight and strength loss.

Physical Anomalies. Liver enlarged 6 cm. below rib edge, tender; pain on pressure over common duct and duodenum; undernourished.

Laboratory. Moderate secondary anemia; gastric achlorhydria; unsplit fat in stools.

Roentgen Ray. Gastro-enterostomy stoma freely patent; dilated jejunal loop.

Gall-tract Aspirations. 1. 600 cc turbid dark, mucoid bile, containing pus, epithelial debris, excess cholesterin and bile pigment from duodenal-jejunal loop.

2. 1200 cc black-brown, thick bile from common duct and liver radicals, containing pus, streptococci, pneumococci, excess cholesterin, and mucus masses.

Treatment. Semi-weekly biliary-tract drainage, through duodenal tube.

Result. Liver returned to normal size, clear normal bile now the rule (several canary-seed size calculi secured); disappearance of diarrhea and lenteric stools; a gain in weight, strength, vigor and

physical comfort, with ability to handle much more advanced position in educational work.

Number of Drainages. Very frequent, at steadily lengthening intervals during past two years, now about once a month.

Report of Case XXXIII.—Illustrative case with relief of severe migraine of hepatic etiology. (Compare with Cases V and VI.)

Mrs. A. J. A., aged forty-seven years.

Past. Scarlet fever. Operations: Ovariectomy.

Recent. Ten years of severe intermittent headaches; accompanied by malaise, anorexia, nausea, vomiting, intestinal stasis.

Present. Practically continuous general headaches; constant gassy type of dyspepsia; weakness; prostration.

Examination. Weight 83 pounds; height 5 feet 7½ inches; temperature 96.2° F.; pulse 108; respirations 14.

Physical. Pale, sallow, undernourished; myocardial weakness; blood-pressure systolic 92; diastolic 64. Liver, two fingers breadth below right costal arch. Gall-tract tenderness over theoretic gall-bladder zone. Colon, moderate atonic dilatation.

Laboratory. Blood: Hemoglobin: 70 per cent; red blood cells 3,376,000; white blood cells 9,400; polymorphonuclears, 72 per cent; Wassermann 0. Urine: No anomaly. Stool: Scybulous stool, exhibiting no other anomaly. Stomach: Free HCl 24, total acidity 64, no retention. Basal metabolic rate 16 per cent. Blood chemistry: Nitrogen, 167 mg. per 100 cc blood; creatinin 2.5 mg. per 100 cc blood.

Biliary-tract Drainage. Duodenal and common duct fractions exhibit no anomaly. Gall-bladder and hepatic duct fractions, 120 cc olive green, turbid, musty odor, thick mucoid, consistency. *Microscopically:* Pure culture colon group, much cholesterin and pigment.

Treatment. Daily biliary-tract drainages; liquid diet; urotropin. Total drainages, 11.

Result. Bile culture negative, after seventh drainage, with bile of normal appearance and flow. Liver lost at costal arch, marked improvement physically; with subsidence of dyspepsia; and amelioration of headaches (well, after twenty months).

Report of Case XXXIX.—Case illustrating value of biliary-tract drainage, in conjunction with direct transfusion of whole blood in hemolytic anemia. (Compare with Case XLIII.)

Mr. J. A. E., aged forty-two years.

Past. Scarlet fever; tonsillitis.

Recent. Overwork and irregular hours for rest and meals.

Present. One and a half years ago began to tire on moderate exertion, felt weak and "lazy"; heart palpitated; dizziness; insomnia, anorexia, very constipated; pallor excited comment.

Examination. Temperature 98.2° F.; pulse, 110; respiration 28. Skin: Shiny, lemon-yellow; lips cyanotic; edema, about ankles. Heart: Dilated left ventricle. Lungs: Basal edema. Liver: Just palpable, tender over gall-tract zone. Colon: Gassy distention.

Laboratory. Blood: Hemoglobin 20 per cent; red blood cells 720,000; color index 1.4 per cent; white blood cells 2,300. Lymphocytes 54 per cent; polymorphonuclears 39 per cent; eosinophiles 7 per cent; many normoblasts; few megaloblasts; platelets scanty. Urine: Albumin, trace; casts (granular and hyaline); 'phthalein 30 per cent; 180 cc urine passed in twenty-four hours. Urobilinogen present. Stool: No parasites; blood in trace; urobilinogen +; colon type bacilli; Stomach: Achylia; no retention. Basal metabolism rate 26 per cent.

Biliary-tract Drainage. 1. Smoky duodenal fraction (urobilin and urobilinogen).

2. Common duct and gall-bladder fraction: Brownish, thick, muco-purulent (200 cc). *Microscopically:* Pus, red blood cells, epithelial débris. Culture: *Streptococcus viridans*.

3. Hepatic duct fraction 300 cc, smoky-brown granular sediment. *Microscopically:* Pus; red blood cells; blood derived pigments; streptococcus. *Roentgen ray:* No gall-tract calculi; enlarged heart and aorta; colon and stomach negative.

Treatment. Metapyloric gall-tract drainages; whole blood transfusions; cleaning gums; tonsillectomy; autogenous vaccines; arsenic; low fat diet; rest.

Result. After two years patient at work; weight, gain 26 pounds, feels well, red blood cells 4,640,000; hemoglobin 85 to 90 per cent, white blood cells 8,200; polymorphonuclears 70 per cent; no nucleated red blood cells. Gall-tract drainage, exhibits few streptococci; liver normal size.

CHAPTER XXXV.

REPORTS OF CASES.—(CONTINUED).

Report of Case XL.—Illustrates the damage to many vital organs and functions following oral sepsis and multiple transplanted foci of infection. Also the potential, if not actual, damage to different organs as a result of various infections.

Mrs. E. E. C., aged fifty-three years, was first seen by me on April 7, 1916.

Chief Complaint. Pain in back.

Past Medical History. All childhood diseases, including scarlet fever and diphtheria up to age of fourteen, with second attack of diphtheria at age forty-five. Typhoid fever at forty-three years of age. No operations.

Present Illness. Had attack of typhoid fever ten years ago, very severe, accompanied by bowel hemorrhages and severe intermittent attacks of upper right quadrant pain, suggesting cholecystitis. Duration two months. During last three weeks of convalescence edema of hands, feet and abdominal tissue. Apparently no free fluid. For a year following, intermittent attacks of upper abdominal pain suggesting cholecystitis. During the second year two attacks of upper abdominal colic requiring morphia. Never jaundiced. General health good until two years ago, when she suddenly began to complain of dull aching pain in lower mid-back, which radiates around flanks to abdomen, but does not point, nor is it referred to upper back or shoulders. Lesser complaints of postmeal pressure, fulness and gassiness, relieved by belching. Menopause reached one year ago, and is still nervous, with vasomotor disturbances.

Physical Examination. Overweight, but healthy looking woman. Upper teeth false. Lower gum margins clean. Tonsils negative. Lungs and heart normal. Abdomen: Localized tenderness at gall-bladder point with involuntary rigidity. To fluid and gas inflation, and tuning-fork auscultation, her stomach is apparently pulled over to right and suggests adhesions to gall-bladder.

Diagnosis. Cholelithiasis, with chronic cholecystitis and associated achylia gastrica. Patient referred for operation.

Operation. April 19, 1916, by Dr. George G. Ross. Gall-bladder chronically inflamed, containing one large mulberry gall

stone, size of hickory nut. Pylorus and duodenum pulled over to right and adherent to under surface of liver. Cholecystectomy by high cystic duct ligation.

Follow-up. With the exception of continued abdominal gas and belching, patient remained well until May, 1917, when she developed diarrhea, which persisted despite all forms of treatment for the next two years. In May, 1917, her physical examination was negative except for beginning oral sepsis involving lower teeth, which had come on during the past year. Three weeks later all lower teeth were extracted, gums cleaned up and well fitting double plates were made. The diarrhea was particularly severe, with bloody, frothy motions, ten to twenty a day. Toward the latter half of 1919 diarrhea became gradually controlled by substitution gastric, hepatic and pancreatic products.

On account of the war I did not see her again until November, 1919, when her condition was much improved and she then remained well (without any further diarrhea for the next two years), until she came in on September 24, 1921, complaining of cardiac palpitation with missed beats; frequent canker sores in mouth; and severe headaches suggesting biliary-tract migraine. Her complete achylia has persisted; her urinary function to 'phthalein is normal, although she has moderate edema in feet, ankles and hands, suggesting a beginning Bright's disease, with blood-pressure elevated to 180/110 and a tendency to low specific gravity fixation in night urine. Biliary tract drainage found the common duct open and discharging a deep golden-brown bile suggesting dilatation of ducts or diverticula of cystic duct. Final liver bile relatively normal. Numerous small floccules in first bile obtained contain epithelial exfoliation from duodenum, preserving a definite architectural arrangement of tubules when seen longitudinally, lined with relatively large oval or cuboidal cells distinctly degenerated and containing vacuoles and fine granular cytoplasm. In cross section the glandular arrangement appears as rosettes. White blood cells +2 and occasional masses of bile salts. There were several collections of cells suggesting liver cords; numerous bile-stained bacterial colonies. Culture: Non-hemolytic streptococcus, pure. A vaccine was prepared and administered.

During the next two months marked evidence of failing heart muscle, which responded to gall-tract drainage and vaccine, without recourse to supportive cardiac therapy.

In January, 1922, she went to Nassau, where she was to continue with her biliary-tract drainage every two weeks, but on February 22 contracted yellow fever, accompanied by chills, fever and vomiting and a "green spotting over body." Fever for ten days and joints and muscles sore and painful. On convalescence she drained herself

every other day and at first found her bile *inky-black* no matter how long drainage was continued. This gradually cleared up to a deep golden-yellow. Two months later she went to Miami and developed what she called Dengue fever, with chills, headache, vomiting and skin rash lasting one week. During these two illnesses she lost weight from 148 to 112 pounds. She had no diarrhea during any of this period. Her vaccine administration was interrupted on account of her yellow fever.

By January, 1922, she had regained 20 pounds in weight and was beginning to grow stronger, with few complaints except occasional heart "flops." In October, 1922, when next seen, she stated that she had done splendidly from July to October 4, although she had taken scarcely any drainages. On October 4 she developed severe crampy, frontal and coronal headaches, followed by nausea and vomiting of dark green bile. Vomited twelve to fifteen times from 8 A.M. to 5 P.M., nothing but bile, and headache gradually wore off by 7.30 of the morning of October 5. Since then felt pretty well until October 10, when she came in for an office drainage, arriving with a headache which kept on getting worse, but wore off in six hours after a four-hour drainage, during which 7 ounces of golden-brown bile was recovered. Scleræ and hard palate definitely jaundiced and skin subicteroid, with enlarged liver. Melancholia, with frequent crying spells. Marked drowsiness, high bounding pulse with blood-pressure 240/140. Sent to the hospital and under observation for several days, with sodium nitrite, sodium bromide. Laboratory findings suggest increasing cardio-renal disease with biliary cirrhosis.

During the next four months up to February 16, 1923, she has been given frequent drainages, at first bi-weekly, then weekly and then every second week, with very distinct improvement in all directions. Her drowsiness, melancholia, crying spells have disappeared. Her headaches have gradually decreased in severity, her blood-pressure has dropped to 192. Her jaundice is no longer noticeable and her bile is freely flowing and of a light golden-brown color with negative microscopy. Her cardiac and kidney function is much improved.

Comment. This case is so long and so complicated that a lengthy discussion cannot be made. Briefly, this case represents the early damage to gall tract following typhoid fever and to gastro-intestinal tract following oral sepsis, producing atrophic gastritis, in turn throwing an extra load on the pancreas, liver and intestines. I think it more likely that her explosive diarrhea was due to failing pancreatic function than a result of dysfunction of Oddi's sphincter following her cholecystectomy. Probably many factors rather than simply one are concerned in this protracted diarrhea of two years.

The continued gastro-intestinal infection, together with the attacks of yellow and Dengue fever no doubt contributed largely to the production of biliary cirrhosis and the combination damaged the cardiovascular and renal systems.

Biliary-tract drainage had not been introduced at the time of her recovery from her cholecystectomy. I feel now that had it been possible then to follow up her case with postoperative non-surgical drainage, that possibly some of these later complications involving the liver, heart and kidneys might have been avoided. It is too early to report this case from a standpoint of present management, but her improvement thus far has been encouraging. In a more general way this case report is of interest in emphasizing certain of the points which have been discussed in this book.

Report of Case XLI.—In many ways similar to the preceding case.

Mrs. M. K., aged fifty-five years, was referred on January 24, 1919.

Chief Complaint. Diarrhea in attacks for one and a half years, constant for six months.

Family History. One brother dead of cancer of stomach at the age of fifty-six years. One sister, aged sixty years, operated successfully for gall stones.

Past Medical History. Pneumonia in 1900. Recurring rheumatism.

Operations: No abdominal, but left knee operated on twice in 1917 and 1918 on account of arthritis (curetted exostoses).

Present Illness. Following attack of gastro-enteritis in August, 1917, she developed acute diarrhea which was intermittent in character for a year, and for the past six months has been constant, and steadily increasing from four or five daily movements to an average of twelve or fifteen. She has had no formed movement for nine months. The diarrhea is painless and the motions are sudden spurtings like "dirty water." Odor very offensive. She has no indigestion, eats as she pleases, since she thinks various changes in diet have made no difference in her condition. Gradual loss of strength and weight to a total of 15 pounds. Severe frontal headache, backache, dizziness.

Physical Examination. A very feeble, asthenic woman, looking considerably older than her years. Very marked gingivitis with pyorrhea around the only remaining tooth. Lungs negative. Heart: Myocarditis. Abdomen: Visceroperitoneal type with diffuse soreness everywhere. No rigidity or spasm. Recto-sigmoid: Greatly inflamed mucosa with one small internal hemorrhoid. Spine: Stiffness in lumbar region with immobility. Extremities: Heberden's

nodes, Haygarth's nodosities. Left knee: Hypertrophic osteoarthritis.

Laboratory Examinations. Blood: Leucopenia with lymphocytosis.

Gastric Analysis: Complete chemical achylia. Occult blood positive. Constant fasting biliary regurgitation. Absence of pro-enzymes. Pancreatic ferment insufficiency, chiefly of trypsin and steapsin.

Urinalyses: No anomalies.

Stool examinations: Liquid, dirty brown, odor offensive. Evidence of ileocolitis, with gross food rests, increased mucus, muscle fiber, striated and unstriated, neutral fats. Occult blood +.

Roentgen ray: Probable adhesions between gall-bladder and duodenum. No calculi visualized. Advanced spondylitis. Large exostoses on second and third lumbar vertebræ. Hypermotility of stomach and large and small bowel.

Diagnosis. Disseminated gastro-intestinal infection, secondary to oral sepsis. Chronic infective atrophic gastritis. Upper right quadrant disease. Chronic osteoarthritis.

Treatment. Extraction of one remaining infected tooth. Treatment of gums. Restriction in fats and animal protein. Milk with gastron; bismuth subcarbonate; salol; chalk mixture.

During the next succeeding six months this patient did badly, with fluctuations in her diarrhea, but no material improvement, and an additional loss of weight of 10 pounds. In August, 1919, her medication was changed to hydrochloric acid and pepsin with meals, taka-diastase with pancreatin after meals, with a continuation of bismuth and chalk. During the next two months there was no notable improvement.

In October, 1919, a diagnostic biliary-tract drainage was done, giving evidence of gall-tract infection and catarrh, with atonic gall-bladder containing inky-black, static bile. Therapeutic drainages begun and continued at weekly intervals for several months, with progressive improvement as regards her diarrhea, but a progressive loss of weight during the next year of 5 additional pounds, making a total loss of 30 pounds. Notwithstanding this, her general stamina and endurance was distinctly improved. Her headaches, dizziness and diarrhea were all under control, although the latter showed tendency to flare-backs.

By June, 1921, her diarrhea was controlled, and since then has averaged two bowel movements a day, usually of the "alarm-clock" type, waking her about five in the morning, with a second and occasionally a third movement before 11 A.M. She had picked up 10 pounds in weight and her drainage findings were distinctly improved, and her symptoms seemed to be well controlled by drainage every three to five weeks.

During 1922, her improvement continued, and she gained an additional 7 pounds in weight. Eleven drainages during 1922, and gall-bladder fractions were a light golden-brown as contrasted with the earlier inky-black and black-browns.

Final Follow-up. February 12, 1923. Symptoms controlled. General health very distinctly better, stamina and endurance increased. Headaches very rare, no further progress in the osteoarthritis. At the present time and for several months patient has taken no medicines.

Comment. This case represents a very commonly met with clinical condition, a disseminated gastro-enterocolitis starting with oral sepsis, leading up to progressive atrophic gastritis, with secondary damage to liver, gall tract and pancreas. These cases are frequently associated with disturbances of the hematopoietic system, many of them developing pernicious anemia, certain of them grave secondary anemias. Certain forms of osteoarthritis are not uncommon sequelæ. Biliary-tract drainage, when added to the commonly accepted methods of medical management, has been found to carry these cases further than I have hitherto found possible. It is to be noted that no vaccines were used in this patient's case. This was somewhat of a surprise to me and indicates an error of omission that frequently takes place in an out-clinic patient, where lapses of this kind are more apt to occur.

There have been periods within my recollection of this case where her general appearance was that of an advanced anemia, but in searching the out-patient records, for which I was responsible, I find a gross negligence occurred in following up this aspect of her case. It is by such humiliating memories that we strive to perfect our daily work.

Report of Case XLII.—Illustrates progressive osteoarthritis of long standing improved by biliary-tract drainage and vaccines, with arrest in progress of disease and increased mobility of joints.

(Case No. 1146).—Mr. H. R., aged forty-six years, was referred on April 11, 1921.

Chief Complaint. Chronic rheumatism with pain in almost every joint.

Past Medical History. Neisserian infection in 1898 with several recurrences. Typhoid fever in 1900, duration five weeks, no complications or relapses.

Operations: Tonsillectomy 1918, although no history of tonsillitis, without any improvement in arthritis.

In good health up to twenty years ago, except for progressive constipation, the result of careless habits in childhood. In 1901

developed pain in right great toe, could not walk, was laid up for six months at Mount Clemens. At this time toe was red and swollen and gradually the rest of this foot and the small joints of the left foot became involved. Ten years ago toes became deformed, ankylosed, and since then have not been as painful. Since onset in foot most of large joints have become involved with stiffness and pain. Involvement of large joints insidious, but in small joints, especially fingers, the onset was acute, with swelling, redness and surface tenderness, gradually subsiding and leaving a deformed, enlarged and stiffened joint. In the large joints each exacerbation left an increase in ankylosis. Bath treatments once a year without relief. All other foci except gall-bladder have been excluded. One year ago had an attack of rheumatic iritis.

In 1918 suffered an attack simulating pleurisy, which his physician found by roentgen ray to be due to an arthritic involvement in the thoracic costovertebral joints. In November, 1918, was investigated at the Mayo Clinic for two weeks and no focus found except in tonsils, which were removed at their request three months later. An autogenous vaccine of *Staphylococcus aureus*, together with a vaccine of *B. coli*, was administered without any improvement whatever. Loss of weight 7 pounds. Increasing dyspnea and cardiac palpitation on slight exertion. Chronic bronchitis for several months. Insomnia, partly due to pain.

Physical Examination. Temperature, pulse and respiration normal. Blood-pressure 116/78. Skin: Xanthoma planum, especially about inner canthi of eyes. Teeth, gums, sinuses, ears, negative. Lungs: Chronic capillary bronchitis. Heart: Hypertrophy, myocarditis. Abdomen: Only slight relative rigidity in upper right quadrant, with doubtful tenderness over gall-bladder region. Rectosigmoidoscopic: Mucosa inflamed, granular, thickened, with mucopus feces. Sigmoid spastic at 10". Spine: Dorsal region is tender and fixed with forward arching. The only motion in spine takes place in lumbar region. Extremities: First phalangeal joint in left finger has a spindle-shaped enlargement, with limitation of motion and slight ulnar deviation. Great toes are turned up and fixed, and, to a less extent, the second and third toes. Absolute loss of mobility of all joints and small bones in feet, and foot feels as if cast in iron. Both patellæ enlarged and motion produces crepitation, which is also noticed in both shoulder joints. On account of the rigidity of his back and spine, associated with the stiffness in knees, he has to ease himself into and out of a chair by his hands. He uses double canes and gets about with great difficulty. Prostate: Moderately enlarged, not tender. Fluid obtained by massage shows definite evidence of chronic inflammation and infection, but gonococci regularly negative in Gram-stained smears.

Laboratory Examinations. Blood: Hemoglobin 95 per cent; white blood cells 12,240; polymorphonuclears 62 per cent; transitionals 2 per cent; large mononuclears 1 per cent; lymphocytes 34 per cent; basophiles 1 per cent. Wassermann negative. Complement-fixation for gonococci negative.

Sputum: Negative for tubercle bacilli. Many streptococci.

Urinalyses: Negative except for indicanuria ++. 'Phthalein study—57 per cent in two hours.

Stools: Mushy, fermentative, incorporated mucus, gross food rests. Occult blood positive. Fatty acid +3; unstriated muscle +2; soaps, cellulose, yeast, all +1. Bacterial flora increased. Gram-positive-negative ratio disturbed.

Gastric Analysis: Marked hyperacid catarrhal gastritis, with congested mucosa. Typical extragastric curve reaching a high point of free HCl 90, total acidity 140 at one hundred and twenty minutes. Microscopy of fasting residuum: pus cells +2 and colonies of cocci in association with exfoliated gastric epithelium.

Biliary-tract Drainage (Diagnostic). Delayed duodenal entrance time apparently due to pylorospasm, relaxing with atropin. "A" and "C" biles promptly recovered, but no "B" fraction. Enormous amount of shaggy flocculent debris, heavily bile stained, with here and there brighter lemon-yellow patches. Microscopy: Pus cells +2, low columnar and cuboidal bile-stained epithelium, dense spiralled, twisted strands of mucus, encrusted with bile salts. Many fields contain the bright lemon-yellow masses resembling neutral fat globules, with a tendency to coalesce into pools and lakes, and retain Sudan III stain. This appears to be suggestive of cystic duct obstruction from within (see page 331). Numerous colonies of bile-stained cocci. Culture: Non-hemolytic streptococcus (pure recovery).

Diagnosis. Chronic hypertrophic arthritis, progressive, with disseminated gastro-intestinal foci. Chronic cholangitis and chole-dochitis, with cystic duct obstruction.

Treatment. Hospitalization, one month. Continuous biliary-tract drainage for three weeks, during which time he gained 7 pounds. Autogenous vaccines. Prostatic massage. Sodium iodide intravenously. Thymus gland by mouth. Baking and later massage of joints. Expectorant treatment: Capillary bronchitis. Hygiene. Occasional colonic irrigations and rectosigmoidoscopic topical treatment.

Progress of Case. On the third day of continuous drainage the evidence for cystic duct obstruction disappeared and "B" fraction (very static, inky-black bile) was recovered, loaded with streptococcal colonies and numerous exfoliated, tall columnar epithelial cells and inflammatory debris.

By this time acute joint pain had subsided, mobility of joints, while slightly improved, did not show any striking improvement in ankylosis, although patient could move about much more freely and could rise and sit with less effort and without assistance.

Intermittent drainage continued at home irregularly until the following March, 1922, when a special technical nurse was sent out to him and a second intensive course of treatment was given by daily drainages, averaging four hours' duration, for three weeks. At first all biles were again found thick and catarrhal, but with large "B" fractions, gradually growing less in amount, and all biles clearing rapidly. At first Oddi's sphincter was always found open, but after two weeks this dysfunction was controlled. Clinically, *before* this second course of treatment was begun, he had improved very markedly, showing much greater mobility in joints, no pain, marked decrease in headaches, and a total gain in weight of 17 pounds in nine months, and was actively going about his business.

In reply to a follow-up inquiry, Dr. S. H. Sedwitz, of Youngstown, Ohio, writes on February 21, 1921.

"Mr. R.'s arthritis is very much improved. Occasionally he has some slight pains. Of course a large number of his joints are permanently fixed, none the less he is able to attend his business, and owing to the financial stress, he is compelled to do more than ever himself. I have not had occasion to see him professionally for three months, and that was for his persistent bronchitis. Occasionally, at his fancy, he drains himself. All in all, he is much improved and the previous rapid progress of his arthritis seems to be arrested. He has gained in all 25 pounds in weight.

Comment. This case illustrates an advanced type of chronic osteoarthritis with all extra-abdominal foci (except bronchitis) removed, but active (although concealed) foci in gastro-intestinal tract, especially involving gall tract, and responding to non-surgical drainage and autogenous streptococcic vaccines. As suggesting the specificity of the latter, it is worth while mentioning that many of the injections were followed by focalizing reactions producing exacerbation in upper right quadrant symptoms and findings. Furthermore, it is worthy of record that, whereas no improvement followed the use of Staphylococcus aureus vaccine from tonsils and B. coli vaccines from intestinal tract, some definite response was secured by streptococci recovered from the sputum, gall ducts and gall-bladder. It is too much to expect any definite improvement in joint structures damaged to the point of complete ankylosis. Nevertheless, the subsidence in pain, somewhat increased mobility of joints and ability to resume active work is a great boon to a chronic arthritic invalid.

CHAPTER XXXVI.

REPORTS OF CASES.—(CONTINUED).

Report of Case XLIII.—Illustrates chronic inflammatory disease of upper right quadrant, with severe pyogenic infection, transplanted from respiratory tract, resulting in a grave secondary anemia. Very unusual improvement following biliary-tract drainage and vaccines.

(Case No. 1351).—Mr. C. B., aged sixty-five years, referred June 12, 1922, by Drs. Le Compte and Gibbon.

Past History. Tonsillitis. Chronic nasopharyngitis. Malaria. Attacks of lumbago.

Recent History. Attacks of asthmatic shortness of breath, controlled by aspirin; cardiac palpitation.

Present History. Dead aching pain, upper right quadrant, relieved by taurocol; occasional attacks of more severe upper right quadrant pain after a hearty meal, relieved by belching. Increasing lassitude, drowsiness and pallor, the latter exciting comment. Bronchorrhea. No loss of weight. Bowel function and stools normal.

Physical Examination. Noticeable pallor of lemon-yellow tint. Marked dyspnea; temperature 97° F.; pulse, irregular in rate and force—84 to 120, accelerating on slight exertion; respiration 24; blood-pressure, very labile, ranging from 155/95 to 200/140. Mucous membrane pale. Lips slightly cyanotic. Left supratonsillar crypts contain caseous material. Lungs: Emphysema. Heart: Hypertrophied. Myocardial weakness. Soft systolic apical murmur (hemic?).

Abdomen: Quite marked rigidity upper right rectus, with indefinite sense of mass (gall-bladder?, pylorus?). Liver slightly enlarged.

Laboratory Examinations. *Gastric Analysis:* Moderate hyp acidity, reaching high point of free HCl 20, total acidity 40 at one hundred and twenty minutes. Fasting and digesting biliary regurgitation. Increased mucus. Occult blood negative in all fractions. Microscopy negative. Duodenal entrance time twenty minutes. No pyloro-duodenal obstruction. Duodenal extractions normal.

Biliary Drainage: Common duct open without stimulation. No "B" bile recovered. Cystic duct obstruction (?). Microscopy:

Pus cells +1; bile-stained mucus +1; cholesterin crystals +1. Culture: "C" fraction—heavy staphylococcus aureus, light B. coli.

Stools: Fatty acids, soaps, striated and unstriated muscle +. Occult blood negative. Gram smears: short chains of cocci.

Urine: Normal findings except indican +. Phthalein 50 per cent in two hours.

Blood: Hemoglobin 30 per cent (Dare). Red blood cells 2,940,000; color index 0.5; white blood cells 6,160; polymorphonuclears 75 per cent; transitionals 5 per cent; large mononuclears 2 per cent; lymphocytes 17 per cent; eosinophiles 1 per cent. Poikilocytosis. Anisocytosis. No nucleated reds. Malarial plasmodia negative.

Roentgen Ray. Enlarged heart. Prepyloric filling defect suggesting penetrating gastric ulcer, but with complete lack of spasm, leading to suspicion of malignant degeneration. Gall-bladder not visualized. No stone shadows.

Preliminary Diagnosis. Major: Carcinoma (?) (probably pyloric, non-obstructive scirrhus) with secondary anemia, *versus* pernicious anemia (atypical) *versus* gall-tract disease with hepatic infection.

Collateral: Myocarditis with cardiac hypertrophy. Mitral insufficiency *versus* hemic murmur. Emphysema.

Prognosis. Doubtful.

Plan of Treatment Advised. Immediate exploratory laparotomy to be preceded by blood transfusion. Opinion declined and patient desired recheck examination and was referred to Dr. J. M. T. Finney and Dr. Thomas Brown of Baltimore, who independently came to the same opinion.

Mr. B. then entered the hospital. Blood typed No. III. No members of the family proved acceptable donors and patient had antipathy to any alien blood. Another biliary-tract drainage was done with immediate symptomatic and blood picture improvement. On the fourth drainage hemoglobin had risen to 52 per cent and red blood cells to 4,910,000, and for the first time *gall-bladder* fraction was secured, giving a recovery of Staphylococcus aureus and hemolytic streptococcus. Microscopically: Bile-stained pus cells +2, low columnar epithelium +2, cholesterin crystals +1, mucus and inflammatory debris +2.

Cultures were then taken from postnasal secretion, which recovered non-hemolytic streptococcus, staphylococcus aureus, Type IV pneumococcus. These were mixed with the bile cultures and inoculations begun.

By the seventh drainage the blood count had risen to hemoglobin 89 per cent; red blood cells 5,550,000, but the leukocytes had increased to 11,000 with approximately the same differential count.

Progress of Case. At this writing, February, 1923, Mr. B. has had eleven drainages and is undoubtedly very much better. All cardiac symptoms have disappeared, the costal margin dull ache has been absent for several months, the drowsiness is no longer commented on and he has gained 7 pounds in weight, which is higher than in recent years.

Comment. This case has not been under observation long enough to predicate the final outcome. It does not seem likely now that he could have had cancer. His grave anemia could not have been accounted for on the basis of a bleeding gastric ulcer, since occult blood was negative in stomach, duodenum or stools, and there was no history of accountable blood loss. His blood picture was not that of pernicious anemia, but rather a grave type of secondary anemia which may possibly be accounted for by a gall-tract infection with a very hemolytic type of streptococcus. The question of exploratory operation has been reopened for the surgical risk is now much better, but both the patient and Dr. Gibbon prefer to continue with his present plan of management.

Report of Case XLIV.—Illustrates the possible hopefulness of adding non-surgical drainage of the gall tract to the total management of the diabetic patient. It also presents certain theoretical premises for consideration, and indicates the necessity of following further avenues of research.

Mr. E. H. B., aged thirty years, was first seen by me on October 13, 1921.

Chief Complaint. Diabetes since August, 1919. Weakness. Otherwise feels well.

Family History. Negative, except maternal aunt had diabetes.

Past Medical History. Tonsillitis in childhood. 1907, double otitis media. 1910, football injury to mid-back (not severe). 1911, catarrhal jaundice, one month's duration. 1912-13, thirty to forty boils.

Present Illness. Was well up to 1919, when loss of weight, excessive thirst and weakness, led up to medical examination, at which time glycosuria was found. Since then has been directly or indirectly under the care of Dr. Joslin of Boston. During this time he has been kept sugar-free, except for short period during change in diet. If glycosuria does appear it can usually be controlled by several days' dieting. During the past two years he has lost weight continuously from 175 pounds down to $95\frac{3}{4}$, and his carbohydrate and total food tolerance have slowly but steadily decreased until at present he is sugar-free on carbohydrate 33 grams, protein 54 grams, fat 90 grams, a total caloric food value of 1158.

While still under Dr. Joslin's care in August and September, 1921, his blood sugars were as follows:

August	29		0.09 gm. per 100 cc blood			
September	6		0.28	"	"	"
September	8		0.20	"	"	"
September	13		0.27	"	"	"
September	16		0.24	"	"	"
September	22		0.20	"	"	"
September	26		0.23	"	"	"
October	1		0.22	"	"	"
October	7		0.22	"	"	"

Notwithstanding the increased blood sugar, his urine was sugar and ketone-free, and during this period his total caloric food value had been increased from 252 to a maximum of 1244.

At this time he was sent to Philadelphia, accompanied by one of Dr. Joslin's dietetic nurses for the purposes of adding duodenobiliary-pancreatic-tract drainage. No change of any character was made to his dietetic management.

Physical Examination. On arrival, physical examination was featured by emaciation, weakness, mental cloudiness, lack of concentration, flightiness, a sensibility to cold, poor circulation in extremities, apathy. Weight 96 pounds. Twenty-four-hour urine output 3800 cc. Specific gravity 1019. Negative glycosuria. Negative ketones. 'Phthalein 67 per cent.

Blood: Hemoglobin 78 per cent (Dare). White blood cells 8,560; polymorphonuclears 73 per cent; transitionals 1 per cent; large mononuclears 4 per cent; lymphocytes 22 per cent. Blood sugar 0.24.

Biliary-tract drainage was planned for every fifth day, preceded by a blood-sugar determination taken each time on the fasting morning stomach, but had to be cut down to every week to ten days. After his second drainage the blood sugar dropped to 0.15, but from then on steadily increased, with some fluctuations, (See Fig. 175), as follows:

1921	November	4		0.17 gm. per 100 cc blood		
	November	12		0.180	"	"
	November	29		0.204	"	"
	December	10		0.275	"	"
	December	16		0.226	"	"
1922	January	6		0.275	"	"
	January	13		0.273	"	"
	January	20		0.260	"	"

1922	January	27	. . .	0.277 gm. per 100 cc blood			
	February	10	. . .	0.294	"	"	"
	March	17	. . .	0.218	"	"	"
	March	24	. . .	0.315	"	"	"
	May	29	. . .	0.320	"	"	"
	June	5	. . .	0.330	"	"	"
	July	5	. . .	0.330	"	"	"
	August	8	. . .	0.315	"	"	"
	September	25	. . .	0.354	"	"	"

Glycosuria was negative until June, 1922, when the quantitative estimations were

June	12,	. . .	1.7 per cent
August	7,	. . .	1.1 per cent
August	21,	. . .	1.1 per cent
September	25,	. . .	0.78 per cent

at which time the blood sugar was at its highest point of 0.354. The graph (Fig. 175) will show the drainage dates in relation to the blood-sugar estimations, together with the influence of excitement and mental reaction at certain periods.

Biliary-tract drainage findings of importance were:

1. Conspicuous tendency to dysfunction of Oddi's sphincter.
2. Very static, green-black "B" fraction, unusually heavy tar-like consistency, lightening to a green-brown, with general consistency gradually thinning as drainages progressed.

3. "C" fraction: Increased deepening of color to golden-brown, very thick and viscid, gradually returning to light golden as drainages progressed.

4. Cytology: Comparatively little inflammatory reaction, with moderate number of pus cells and occasional tall and short columnar epithelial cells.

5. Bacterial flora definitely increased, appearing in masses, clumps and colonies of cocci, culturally *Staphylococcus aureus* (pure).

6. March 3, 1922. Long, unbile-stained, mucopurulent plug, Y-shaped, like that represented in Fig. 118, extracted in drainage.

Treatment. 1. Biliary-tract drainage from October, 1921, to September, 1922, to a total of forty-five.

2. Autogenous vaccine of *Staphylococcus aureus* from gall tract and hemolytic streptococcus from extracted abscessed tooth.

3. No alteration in Dr. Joslin's dietetic management.

4. Attempted control of patient's general hygiene, recreation and work, with special attention to preserving a contented mental status.

Progress of Case. 1. Biliary-tract drainage: Steadily improving objective findings, with minor fluctuations, to relatively normal gross appearance and later cultural inability to recover *Staphylococcus aureus*.

2. General: Very noticeable improvement in the various presenting factors conspicuous on his arrival, notably, weakness, mental cloudiness, lack of concentration, poor circulation in extremities, apathy.

3. Gain in weight by January 6, 1922, of 8 pounds, permitting diet increase to 1400 calories without "spilling over," and by further weight gain of $3\frac{1}{2}$ pounds to a total of $11\frac{1}{2}$ pounds in four months. Then a series of acute rhino-bronchial colds developed, lasting three months, reducing his weight gain by 3 pounds. During summer of 1922 had a series of staphylococcus aureus boils and one large gluteal abscess with slow healing response. By September, 1922, a further weight loss of 2 pounds. During this period the graph will show steadily rising blood sugars, with apparently a higher renal threshold.

In May, 1922, Dr. J. B. Luckie of California felt that the rise in blood sugar might have some connection with magnesium sulphate stimulations, and suggested substituting olive oil as the stimulant. This was begun on May 22, but the graph will show that this change made no appreciable effect in reducing the blood sugar curve.

During October, 1922, this patient was transferred to the supervision of Dr. Leon Jonas of the Pepper Laboratory, University of Pennsylvania, who had secured sufficient insulin from Dr. F. G. Banting of Canada, to take care of 2 cases. By November 1 he had been given several injections and was unquestionably doing much better. The blood sugars were reduced from 348 mg. to 88 mg. On November 8 the patient died of intercurrent pneumonia after four days' illness following exposure from an automobile ride.

Dr. Jonas was kind enough to furnish me with the following data from his records on date of admission on October 14 and November 4, just before his final illness.

	<i>On Admission, October 14.</i>	<i>November 4.</i>
Blood sugar	348 mg.	88 mg.
Calories	742	1309
Protein	54	61
Carbohydrate	38	100
Fat	40	40
Weight	97	100
CO ₂	35	57
Ketones	4.82	0
Glycosuria		27 gm. in 24 hrs.
Total nitrogen		7.43 gm.
Total number of units of insulin injected		210

Comment. The abrupt termination of this case was a very great disappointment, when it was beginning to appear that a more favorable result might have been secured by a combination of several plans of management (dietetics, biliary-tract drainage, insulin). This case is reported to draw attention to the following interesting theoretical possibilities.

1. Note the incidence of a catarrhal jaundice of one month's duration in 1911, *antedating* the first known appearance of diabetes by eight years. In going over diabetic records a suggestively large number of cases have been found to give a history of catarrhal jaundice occurring at varying intervals before the beginning diabetes. Has this some significance? Let us remember that during the period of skin jaundice the work of Rous and McMasters suggests that some 75 per cent to 95 per cent of the total excreting surface of the liver is blocked off. This gives rise to a swollen, sometimes tender liver, with an increased intra-hepatic tension, causing pressure changes on hepatic cells which are functionally damaged to a point which in certain cases may make the individual more likely to develop later hepatic and gall-tract disease.

From a similar line of reasoning we might remember that the major pancreatic duct empties into the common duct before it enters the duodenum in over 70 per cent of cases, and therefore during the period of common duct block due to catarrh, the external pancreatic secretion, as well as the biliary secretion, may be blocked off. Witness the mucus plugs occasionally recovered from such cases (see Fig. 117). If the external pancreatic secretion is blocked off this may give rise to increased intra-pancreatic tension. Is it conceivable that in certain cases which later develop diabetes, the lines or pressure points of this increased intra-pancreatic tension may focus *particularly upon the islands of Langerhans*, and by pressure impair or destroy the functional activity of the cells presiding over the pancreatic internal secretion?

2. How does biliary-tract drainage (which, due to the usual anatomical arrangement of the major pancreatic duct, must include pancreatic drainage) theoretically serve to ameliorate pancreatic diabetes? There are several attractive hypotheses.

(a) If the pancreatic duct is plugged with mucus, creating retention of external secretion, this can often be relaxed and proved by the recovery of pancreatic ferments after the obstructive plug has been removed. (See Fig. 118.)

(b) In the performance of a biliary-tract drainage a certain portion of the mixed fluids withdrawn represent external pancreatic secretion. This secretion, if allowed to empty into the duodenum, acts upon the carbohydrate intake, and more rapidly converts it into sugars, which the diabetic patient has difficulty in burning up, and

the excess is stored in blood and excreted by kidneys. By removing, through biliary-tract drainage, a certain amount of external pancreatic secretion, the carbohydrate intake is not so rapidly converted into sugar and the fatigued or pathologically injured cells of the islands of Langerhans are given a chance to rest and recuperate.

(c) By biliary-tract drainage the glycogenetic function of the liver may be improved so that it may be able to "warehouse" more sugar without its being absorbed into the blood and excreted by the kidneys.

These are purely hypothetical theorizings which indicate some of the trend of future investigative research which should be carried on.

3. This case represents one of the severe forms of diabetes in a young adult, with an essentially gloomy prognosis. It will be noted that with no interference in the dietetic management, biliary-tract drainage over a period of one year materially improved many features of this patient's general health, permitting a gain in weight and an increased caloric intake without "spilling over" in glycosuria, until a point where added respiratory tract infection and a skin infection, with diminished resistance to *Staphylococcus aureus*, temporarily stayed the favorable progress. It is also somewhat suggestive to see the recovery of a pure *Staphylococcus aureus* from this patient's gall tract.

4. Dr. Luckie of California has kindly shown me a manuscript, yet unpublished, reciting the improvement secured in a series of diabetics by biliary-tract drainage. In conditions of this sort, representing certain of the problem diseases in medicine, it is questionable whether any single method should alone be utilized, and perhaps in the future it may be seen that the best results attainable will be secured by a *combination of several methods of attack* (dietetics, according to the modern methods introduced by Joslin, Allen, and Geyelin; intravenous use of insulin or iletin; biliary-tract drainage).

Report of Case XLV.—Recites the improvement secured in a case of hemolytic jaundice with splenomegaly by biliary-tract drainage and vaccines.

(Case No. 1072).—M. H. A., aged twenty-five years, was referred to on October 25, 1920. He is by occupation a draughtsman, and his most important personal complaint was that he was afraid he would lose his position because of an overpowering drowsiness that made him fall asleep at his work. His drowsiness was so great that he could not stay awake during the most exciting play or moving picture. With this drowsiness was a progressive sense of fatigue, noticed during the past year, and a gradual loss of mental keenness during the preceding five years. Prior to this he had considered

himself in robust health until he first began to notice dizziness and mental hebetude. In March, 1917, and again a year later, he had attacks of jaundice, with no other symptom except loss of appetite, furred tongue, headache, drowsiness and constipation. Both of these attacks suggested at the time a simple catarrhal jaundice, and the cloudy urine and light colored stools cleared up in several weeks, yet he continued to have dizziness, increasing drowsiness, increasing fatigue, cloudy urine after excess of sweets and bi-monthly attacks of frontal headaches and more or less slight jaundice of the scleræ. About a year ago he became more positively jaundiced, with cloudy, reddish-brown urine, but no noticeable absence of bile in his stools. During this year he says he has grown very melancholic and pessimistic, although he has nothing to account for it. He has lost 12 pounds during the past year and now weighs 158 pounds.

Except for belching immediately after meals and avoidance of sweets, onions and coffee he had no gastro-intestinal complaints. Other than recited he had had no previous infection except recurrent tonsillitis during childhood, for which his tonsils were removed when he was seven. From the ages of fifteen to nineteen he had acne vulgaris very badly.

The salient points in his physical findings were as follows: Large frame, good musculature. The face is broad, forehead narrow and low and heavy lower jaw somewhat of the acromegalic type. The lids are puffed, the hair grows low on forehead and temples and is thick and stiff. The fingers are slender, however, with thumb moons only. The skin is quite markedly jaundiced and shows acne pustules and old scars. The scleræ and roof of the mouth are also jaundiced. Hypertrophic rhinitis and catarrhal pharyngitis. Tonsils are out and tonsillar fossæ are clean. Tongue slightly coated but firm. Gums clean. Teeth regular except one non-erupted wisdom. Posterior cervical and left epitrochlear glands are palpable. Reflexes normal. Lungs and heart normal.

Abdomen. Distinct upper abdominal fulness. No tenderness, muscle rigidity or spasm. Liver enlarged downward, the hard, rounded edge being palpable to 10 cm. below the costal margin. The spleen is greatly enlarged and hard and extends into the left abdomen to the navel. The edge is rounded rather than sharp. Splenic dulness is enlarged in its percussion area well back into the left flank.

Technical Examination: Blood Wassermann negative. Hemoglobin, 93 per cent; red blood cells, 4,740,000; white blood cells, 9500; polymorphonuclears, 65 per cent; lymphocytes, 25 per cent; large mononuclears and transitionals, 6 per cent; basophiles, 3 per cent; eosinophils, 1 per cent. There was no change in shape of the red blood cells, but a noticeable microcytosis (common in

hemolytic jaundice (Crawford). There was also an increase in skeined or reticulated red cells to 3 or 4 per cent. Coagulation time, five and a half minutes (slide and horseshair). A fragility test of his blood on November 29, 1920, by Dr. E. B. Krumbhaar showed complete hemolysis up to 0.40 per cent NaCl, and partial hemolysis up to 0.60 per cent NaCl. This is a distinct lessening of both maximal and minimal resistance and points to a hemolytic factor in the production of his jaundice. This type of jaundice was also suggested in the absence of bile findings in his *urine* and the presence of urobilin in the *stools*, both of which were otherwise negative.

Stomach. The fractional curve was one of hyperacidity, reaching its maximum of 110 total acidity and 80 free HCl at from seventy-five to one hundred and five minutes. No occult blood. Slight biliary regurgitation at seventy-five minutes. Normal amount of mucus. Motility normal. Fasting residuum: Study suggested an infective exfoliative gastritis.

Duodenal Examination. Disclosed an infective exfoliative duodenitis.

Biliary Drainage. When I came to an observation of his biliary drainage I encountered a type of "B" and "C" biles that I have never seen before in over 8000 examinations. The common duct was closed but opened promptly in response to magnesium sulphate. The "A" bile was a brownish-red, turbid, with increased mucus and viscosity. The transition to "B" bile was very prompt and the gall-bladder appeared to be under tension and discharged 320 cc of a greasy, thickish, paint-like bile of a deep reddish-brown color, turbid and containing many mucopus flocculations. It was delivered with a steady flow as though under pressure. Toward the end of the drainage there could be seen through the glass window in the tube *two* currents of bile, the most dependent one of heavier gall-bladder bile being of the color and consistency of red-brown paint and the upper current a transparent thinner bile, almost Burgundy red in color, similar to but darker than a hemolyzed blood Wassermann tube. This was the "C" or liver bile and also flowed rapidly. Over 12 ounces were recovered in less than an hour.

The microscopical examination of the mucopus floccules from the "B" bile showed many bile-stained oval and cuboidal cells in masses and strands and appearing to have a tubular architecture. Occasional masses of heavily bile-stained tall columnar epithelium were seen. The whole microscopical field was swarming with bacteria in masses and colony formation and the bacteria seemed to be entirely cocci. Culture from this bile gave a pure recovery of a *very* hemolytic streptococcus from which a vaccine was prepared.

Comment. This case was classified as a hemolytic jaundice with splenomegaly, catarrhal infective cholecystodochitis and biliary cirrhosis. After eleven drainages he had made remarkable progress, with a marked subsidence of his presenting symptoms. He was markedly improved in his mental state and in endurance, was keen and alert and no longer falling asleep at his work, and the jaundice was very much lessened. His liver had decreased in size so that its edge was just palpable at the costal margin and, to our surprise, his spleen was so much smaller as to be difficult of demonstration.

Dr. Krumbhaar has told me that in his opinion this was the type of case for which no medical plan of treatment had in the past proved effective and for whom a splenectomy offered the only hope. He urged persistence in the plan of non-surgical drainage and use of vaccines to see what might be accomplished. Up to May, 1921, this man had been given about twenty-five drainages with *progressive improvement*. His skin was no longer jaundiced and there was only a subicteroidal tinging of scleræ and roof of the mouth. His biles were nearly normal in their gross appearance and the cytological picture was much improved. The liver is again of normal size, and although the splenic area to percussion is still enlarged the spleen itself is no longer palpable within the abdomen.

We are extremely interested in the outcome of this case. If the clinical improvement so far secured can be increased or made permanent over an extent of one or two years it will open up an enlarged field of usefulness of this method. I believe that continual duodeno-biliary drainage day and night, over a period of two or three weeks, with an interruption of a like period, might accomplish a prompter and more conspicuous improvement. This plan was suggested to this patient, but declined on the grounds that he was feeling so well that he did not feel justified in absenting himself from his work.

Follow-up. November, 1922 (two years later). This patient continued to take drainage every three to four weeks during the last six months of 1921. This he did himself at home somewhat under protest, for he "felt too well." During 1922, he has had only four drainages and has continued to improve.

Today February, 1923, he says: "I am feeling as well as I ever have in my life. I have had a considerable amount of overtime work and have not felt the strain. My appetite is excellent, I sleep well, I am no longer drowsy and, I think, more mentally keen and alert than I have ever been."

Physical Examination. Weight 172, a gain of 14 pounds. Scleræ, palate and skin only slightly subicteroid. No jaundice.

Liver has come down to normal size and the edge is just barely palpable.

Spleen: Edge is palpable about $\frac{1}{2}$ inch below the costal margin. The percussion limits are greatly reduced, and spleen edge does not seem hard.

While there has been continued and striking clinical improvement, the examination of his blood has not indicated a parallel gain, showing a tendency to fluctuate, which is out of ratio with the clinical improvement. Compare the following blood examinations:

May 16, 1921. Red blood cells, 5,200,000; white blood cells, 11,400; polymorphonuclears, 61 per cent; lymphocytes, 33 per cent; mononuclears and transitionals, 1 per cent; eosinophiles, 5 per cent. Moderate polychromatophilia. Moderate anisocytosis. Occasional stippled cell. Fragility of red blood cells. Beginning hemolysis 0.58 NaCl. Complete hemolysis 0.32 NaCl.

This analysis as regards blood fragility is better than that of November 29, 1920.

July 16, 1921. Red blood cells, 5,060,000; white blood cells, 8,400; skein cells 5.2 per cent. Blood fragility. Beginning hemolysis 0.58 NaCl. Complete hemolysis 0.30 NaCl. This showed a still further improvement.

November 8, 1922. Hemoglobin 95 per cent; red blood cells, 5,110,000; white blood cells, 12,500; polymorphonuclears, 79 per cent; lymphocytes, 16 per cent; mononuclears and transitionals, 3 per cent; eosinophiles, 2 per cent; basophiles, 1 per cent; skein cells 8 per cent. Beginning hemolysis 0.62? NaCl. Complete hemolysis 0.42 NaCl.

Stool: Urobilin excretion in feces 122,000 units.

On this latter date Dr. Krumbhaar writes:

"I am afraid that this shows that, although Mr. A. is much better symptomatically, his blood destruction is greatly increased and the blood cells are more fragile than on the last examination. In other words, he should still be considered to have hemolytic jaundice, though in the stage that Chauffard described as being more icteric than sick. I quite agree with you as to the nature of his improvement and I should think the line of treatment should be continued. Since the cause of these acquired forms are by no means understood, it may be that with continued treatment and improvement it would still be possible to cure him, although I am not quite so sanguine of curing the fragility of his red cells. The urobilin excretion figure in the stools is an extremely high one."

The last biliary drainage done on November 1, 1922, was as follows: Common duct open without stimulation. No "A" bile could be definitely figured on. "B" fraction 210 cc mahogany reddish-brown (Plate X), containing a moderate amount of slimy mucopus floculations. "C" fraction 180 cc golden-yellow, with slight reddish tone. Both fractions much thinner and less viscid than formerly.

PLATE X



Unusual type of bile recovered from case of splenomegaly with hemolytic jaundice. This bile, while still atypical and rarely seen, is very greatly improved over the type originally secured from this patient. (See text.)

Microscopy shows considerable exfoliation of tall columnar epithelium, heavily bile stained, bile salts and bile-stained mucus. Bacterial flora microscopically negative and culturally sterile.

From the foregoing it will be seen how difficult it is to properly determine the exact status of this patient. Clinically and from certain laboratory angles he is conspicuously improved, and might pass as a recovered case were it not for the laboratory evidence in regard to the fragility of his red blood cells and the abnormally high excretion of urobilin in his stools. I shall keep this man under observation as long as he will permit me.

This is one of the problem diseases of internal medicine that heretofore has not been benefited by any means short of splenectomy, but may in the future be successfully combated by this method. A great deal of further work must be carried through before we can understand more thoroughly the underlying factors which are concerned in the production of this condition.

As seen by some of the foregoing case reports, pernicious anemia, grave secondary anemias, hepatic cirrhosis, toxic cholecystodochitis, toxic cholangitis and toxic hepatitis may be benefited by non-surgical drainage of the biliary system. Certain cases of diabetes have been treated and an improvement secured considerably beyond their high point reached by modern dietetic methods.

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Name Mrs. K.

Age 50 Residence Home City Philadelphia

Res
Phone Bus.S. M. W. Occupation ^A Housewife _B

Nativity Penna. Referred by Dr. Despard

CHIEF COMPLAINT: Three or more attacks of violent, central epigastric pain during past year, relieved by belching. For 18 months abdominal distress (sense of bruise) 2 hours or less p.c., somewhat relieved by belching.

FAMILY HISTORY: F. l. w. s. d. 75

M. l. w. s. d. pneumonia
2 stroke Consort well
S. l. w. s. d. Children

T. B. no history Cancer no history Cardiac no history Renal no history G. I. maternal side none for 10 yrs.

PAST MEDICAL HISTORY: scarlet fever, diphtheria, tonsillitis (recurrent), quinsy, rheumatism, influenza, pleurisy, pneumonia, typhoid fever, jaundice, malaria, dysentery, gon., lues, cramps, worms, pyorrhea, appendicitis (chronic), abscessed teeth. 1908 "frozen out"

Operations none

When Where By

Previous Indigestion for the past 18 months

Abdominal Pain as defined elsewhere

Renal System negative. No amaurosis.

Nervous System fidgety; sleeplessness; "horrid" dreams, but refreshed when she does sleep.
Genital System normal.

Cardiac System negative.

Pulmonary System negative.

Ductless Glands negative.

Weight highest 152 one year ago 148
lowest present six mos. ago ?

General Health Robust +
Delicate

Last illness diarrhea for 4 weeks
18 months ago.

GASTRO-INTESTINAL HISTORY.

Appetite Normal Perverted Bulimia Increased
Anorexia Acoria Afraid to +
Satiety

Taste Normal Metallic
Sweet Bitter +
Sour Thick

Breath Normal

O Nausea Constant Intermittent

Lack of abdominal support yes

Thirst normal

Regurgitations none

Sour Acid Bland

Dysphagia +
Aerophagia
Peristaltic Unrest ++

Eats Fast normal

Chews well yes

Skips meals quite frequently

Average Accustomed Diet: well balanced, until present illness.

Carbohydrates

Protein

Fats

Foods disagree eggs, milk, pastries, ice-cream, candy.

Foods agree meats, fowl, vegetables, much pepper, jelly.

Pain or Distress both. Sense of constant soreness like a bruise.

Where

Localized where across epigastrium.

Burning Boring

Sense of weight

Referred where mediastinum

Gnawing Stabbing

" " pressure epigastrium

Constant almost

Grinding Empty

" " discomfort

Intermittent sometimes

Bloating none

Time 2 hrs. or less after meals.

+ Belching, relieved by +++

Relieved by food taking variable

+ Passing gas, relieved by ++

Increased by food taking (liquid) cold

rt. side Pressure helps

Vomiting rare (induced) + (involuntary)

Time 2 hrs. p.c.

Relief prompt Hematemesis never

Character food as eaten, mucus. Difficulty in getting up Retention none
solid food

PERSONAL HISTORY:

Married 26 years Children never pregnant Miscarriages none Tea $\frac{+}{-}$
 began at 14 regular pain Leucorrhea Coffee $\frac{+}{-}$
 Menstruation ceased at 47 duration prostration Alcohol 0
 Sleep states: average hrs. 7 insomnia rare unrefreshed no Tobacco 0
 dreams + nightmares "horrid" twitches + 0 cramps $\frac{100}{100}$ Drugs 0
 Headache rare since glasses Backache none Vertigo none Easily fatigued yes
 Bowel movements: number 3-8 painful no offensive + hard never lack power no
 size bulky mucus none color dark brown Bloody discharges 0 Hemorrhoids +
 shape liquid to mushy 0 Use of Laxatives $\frac{Constant}{Intermittent}$ Diarrhea +
 Constipated: moderately $\frac{Constant}{Intermittent}$ 0 Use of Enemas $\frac{Constant}{Intermittent}$ Tenesmus at times
 obstinately $\frac{Constant}{Intermittent}$

SOCIAL HISTORY: Economic status fair

Ambitions nothing important Regrets nothing important Worries about her illness

PRESENT ILLNESS:

Symptoms Progressing

Mrs. K. considered herself in excellent health until August 1920, when she developed a spontaneous diarrhea, without cause, lasting one month; immediately followed by epigastric distress two to three hours after meals. If the meal was a hearty one, the distress would begin at once. Immediate relief by belching, but not permanent, and some distress would last until the stomach was empty. It was sometimes relieved by peppermint or several proprietary "digestive tablets". She may be pain free for several days to a week, but in general has been getting worse since May 1921. All her life she has had tendency to an "alarm clock" bowel, i.e. wakens with the desire to empty the bowel. Never constipated and has never taken a laxative. Suggestive history for rectal fissure September 1921, lasting two weeks. Most of her lost weight (39 pounds) has occurred within the past nine months, but during this period she has further and further decreased her diet because of distress. Pallor and weakness began four months ago which has been progressive. At first she worried about having kidney trouble, later on about cancer of the stomach, but says she is not worrying now as "I never vomit or get sick".

Provisional (mental) Diagnosis: Gastric carcinoma, Cholelithiasis, Chronic pancreatitis.
 Chronic gastro-enterocolitis, Chronic nephritis.

Report to Dr. Despard

SUGGESTIVE HISTORICAL EVIDENCE: See History Form.

PHYSICAL FINDINGS: T. 98 P. 84 R. 20 B.P. 134/86 (sitting)

Weight, 109 = (gain—loss) 39 lbs. in 12 mos. Height, 5'5"

Habitus, normally sthenic. Posture, stooped.

Hair, greying.

Skin, shallow. 3 small naevæ on chin.

Musculature, poor, relaxed. Reflexes, knee jerks ++

Glands (lymph), no enlargements. biceps ++

Bones and Joints, negative.

Extremities, negative.

Vaso-motor System, moderate tache. Moderate dermatographia. Arteries, very slight thickening

in radials, brachials
and temporals.

Romberg's negative

HEAD:

Face,

drawn. Worried expression.

Eyes,

beginning arcus senilis. No jaundice. Ex. oc. musc. O.K.

Pupils,

small, but equal. React to Rt. Lt.

Ophthalmoscopic,

N.E. L. & A. normally.

Nose, negative

Sinuses,

N.E.

Ears,

Lt. drum head thickened. Rt. perforated, but clean.

Mouth,

retracted, but clean. Show evidence of earlier pyorrhea.

Gums,

widely spaced.

Teeth,

extracted

3rd Molars,

grey-brown coated; tooth marked; flabby.

Tongue,

negative.

Palate,

adherent to tonsils.

Anterior pillars,

buried, atrophic, scarred. Nothing expressed.

Tonsils,

negative.

Pharynx,

negative.

Caps,

Dead,

NECK: negative.

Vessels,

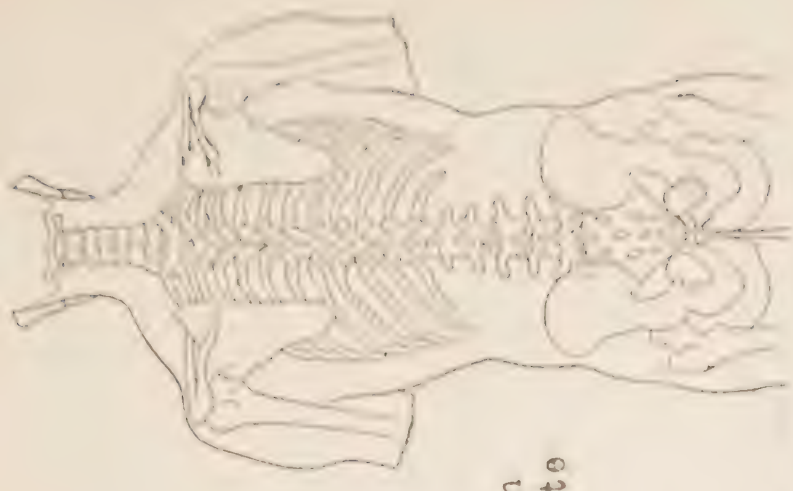
negative.

Thyroid.

negative.

CHEST: Normal except for tissue loss.

Breasts, atrophic
Lungs, poor expansion, poor aeration. Otherwise negative.



Mediastinum, negative to percussion.

Aorta, percussion outlines normal.

Heart, Normal in S. and P. No B., H., S. or T. P.M.I. in 5 i.s. M.C.L. Sd's well heard. Fair quality. Rate slightly accelerated. No reduplications. No M.

Electrocardiograph, none made.

ABDOMEN: formerly obese; recent tissue loss producing striae.

Glenard Test, positive Costal Angle, normal Ptoic Index, .72

Aorta, covered Iliac Arteries, covered

Scar, 0

Reflexes, + Muscular Tonus, relaxed, flabby.

Mass, central to right epigastric--ill defined.

Hernia, 0

Pain, 0

Tenderness, moderate at X.

Rigidity, voluntary!

Adhesions, neg. tuning fork from stomach-colon to C.M. or through liver.

Kidneys, not palpable.

Liver, normal to percussion and palpation.

Gall Bladder, not felt.

Spleen, not felt. Normal to percussion.

Stomach, slight ptosis.

Small Intestine, normal to palpation and auscultation.

Appendix, doubtful tenderness.

Cecum, boggy.

Colon, trans. ptotic!

SPINE: straight. Mod. localized tender Coccyx, negative.

point over rt. trans. proc of 7th

and 8th thoracic vert.



SPECIAL PHYSICAL EXAMINATIONS:

RECTO SIGMOIDOSCOPY:

Anus, tight; erosions posteriorly and some induration.

Rectum, negative except for distended vessels.

Sigmoid, spastic at 8 inches.

PERINE

Vaginal negative.

Uterus: small, retroverted, fixed. No mass.

Adnexa: negative.

EXTERNAL GENITALIA: negative.

ENDOCRINE SYSTEM: negative.

ESOPHAGUS:

Not examined.

SUMMARY OF SPECIAL ANALYTICAL EXAMINATIONS:

GASTRIC EXTRACTS: Fasting: no free HCl, total ac. 15; bile +2; mucus 0; relaxed pylorus with duod. reversed peristalsis. Gag reflex nullified by green bile. Food rests +7. Micros: subacid infective gastritis and extragastric pathology (cf. chart). Digesting: complete achylia; hypermotility +1; bleeding throughout, erosions, congestion? Terminal bile reflux. Wolff-Jungmans: doubtful positive (cf. chart).

Impression: Anacid infective gastritis. Extragastric pathology.

DUODENAL EXTRACTS: Negative.

BILIAL DISCHARGE: Technic on fasting residuum closely approximates first excretion. Gross aspects suggest: Cholelithiasis, Cholecystitis, Dysfunction of Oddi's sphincter. Micros. " " : Cholelithiasis, Infective and Exfoliative Cholecystitis, Giardiasis.

HEPATIC FUNCTION: Not tested.

PANCREATIC FUNCTION: Chronic pancreatitis vs. deficient function suggested indirectly by feces.

INTESTINAL MOTILITY: Carmine appearance 18 hours. Disappearance 57 hours. 5 stools.

FEACES: Red, pungent, fluid. Mucus incorp. +1; Oc. Bl. +1; acid; fermentation +1.

MICROSCOPIC FAT: acids, soaps, starch, cellulose all +1; Giardia cysts; W.B.C. +1; 5/10 Gram pos. = streptococci.

Urine:

1. Chemical: amber, cloudy, acid. 1.028--1.035. Albumin 0, glucose 0, indican +2 and +1, bile 0.

2. Micros. No casts or cylindroids or urate crystals. Vag. epith. +1. No W.B.C. or R.B.C. or bacteria.

3. Special,

KIDNEY FUNCTION: (Intramuscular 'phthalein) 530 c. c. 60 % 2 hrs.

Blood:

Routine Exam. Hb. 82% (Dare). R.B.C. 4,360,000. C.I.=.9 W.B.C. 4,700.
Diff: P. 63%, T. 2%, L.M. 4%, Lymph. 30%, Eosin. 1%. R.B.C. normal.

Chemistry,

Wassermann, neg. 3 antigens.

BACTERIOLOGICAL: "P" fraction = staphylococcus aureus; streptococcus non-hemolyticus.

X-RAY STUDY Enlarged gall bladder full of small stones.

SPECIAL STUDY.

DIAGNOSIS:

- MAJOR, 1. Intraabdominal cancer (gall bladder?) vs. gall stones (proved).
2. Disseminated infection of G. I. tract (atrophic gastritis, cholecystodochitis, ileocolitis, chronic appendicitis).

COLLATERAL, 1. Giardiasis.

2. Chronic pancreatitis?
3. Intestinal toxemia.
4. Secondary exhaustion of nervous system from toxemia.

PROGNOSIS: Guarded.

PLAN OF TREATMENT SUGGESTED:

- | | |
|--------------------|---|
| Diet, | Reduced proteins and fats. Bland. |
| Lavage, |) Postoperative. |
| Biliary Drainage, |) |
| Colonic, | |
| Rectal, | |
| Abdominal Support, | |
| Electricity | |
| Subcutaneous, | Iron and arsenic (later). |
| Percutaneous, | |
| Intravenous, | |
| Vaccine, | Mixed autogenous. |
| Medicinal (oral), | Gastric and pancreatic substitutive therapy. Tonics. |
-
- | | |
|------------|----------------------------------|
| Hygiene, | |
| Exercise, | |
| Rest, | Laparotomy. |
| Operation, | Immediate surgical consultation. |
| Special, | |

FURTHER EXAMINATIONS REQUIRED:

REPORT OF OPERATION: See elsewhere.



